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Kauai II Addendum to the Recovery Plan for the Kauai Plant Cluster

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KAUAI II:
ADDENDUM TO THE RECOVERY PLAN FOR THE KAUAI PLANT CLUSTER

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DISCLAIMER PAGE

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EXECUTIVE SUMMARY

Current Species Status: This document serves as an addendum to the Recovery Plan for the Kauai Plant Cluster published by the U.S. Fish and Wildlife Service in July 1995. This addendum covers 20 plant taxa, 18 of which are listed as endangered and 2 as threatened (*Cyanea recta* and *Myrsine linearifolia*), with numbers of known remaining individuals as follows (number of populations, number of individuals): *Alsinidendron lychnoides* (kuawawaenohu) (4, 50-100), *Alsinidendron viscosum* (no common name (NCN)) (4, 100), *Cyanea recta* (haha) (7, 1,000-1,500), *Cyanea remyi* (haha) (5, 500), *Cyrtandra cyaneoides* (mapele) (5,350-400), *Delissea rivularis* (oha) (3, 35-40), *Hibiscadelphus woodii* (hau kuahiwi) (1,4), *Hibiscus waimeae* ssp. *hannerae* (koki o keokeo) (2, 75-125), *Kokia kauaiensis* (kokio) (6, 105-150), *Labordia tinifolia var. wahiawaensis* (kamakahala) (1, 20-30), *Myrsine linearifolia* (kolea) (8, 1,000-1,500), *Phyllostegia knudsenii* (NCN) (1, 3), *Phyllostegia wawrana* (NCN) (3, 45-55), *Pritchardia napaliensis* (loulu) (3, fewer than 90), *Pritchardia viscosa* (loulu) (1, 4), *Schiedea helleri* (NCN) (3, 43-53), *Schiedea kauaiensis* (NCN) (2,15), *Schiedea membranacea* (NCN) (6, 200-250), *Schiedea stellarioides* (laulihilihi) (1, 500-1,000), *Viola kauaiensis* var. *wahiawaensis* (nani waialeale) (1, fewer than 100). All of these taxa are endemic to the island of Kauai, Hawaiian Islands.

Habitat Requirements and Limiting Factors: The 20 taxa included in this plan grow mostly in the northern and northwestern portions of Kauai, and grow in a variety of vegetation communities (shrublands, forests, and mixed communities), elevational zones (lowland to montane), and moisture regimes (dry to wet). Only one species, *Pritchardia napaliensis,* is found in lowland dry communities. These plants and their habitats have been variously affected or are currently threatened by one or more of the following: competition for space, light, water, and nutrients by introduced vegetation; habitat degradation by feral or domestic animals (black-tail deer, goats and pigs); erosion of substrate produced by hurricane, weathering, human- or animal-caused disturbance and predation by animals (deer, goats, rats, and slugs). In addition, due to the small number of existing individuals and their very narrow distributions, these taxa and most of their populations are subject to an increased likelihood of extinction or reduced reproductive vigor from random, naturally occurring events.

Recovery Objectives: Delist all taxa. Interim, downlisting, and delisting objectives are provided. Recovery of the Kauai II plant cluster taxa should be pursued via the establishment of management units in order to make the most efficient use of available resources in an effort to conserve not only these taxa, but their habitats as well.

Recovery Criteria:

Interim Objectives:
The interim objective is to stabilize all existing populations of the Kauai II taxa. To be considered stable, each taxon must be managed to control threats (e.g., fenced) and be represented in an *ex situ* (such as a nursery or arboretum) collection. In addition, a minimum total of three populations of each taxon should be documented on Kauai, where they now occur or occurred historically. Each of these populations must be naturally reproducing and increasing in number, with a minimum of 25 mature individuals per population for long-lived perennials (*Hibiscadelphus woodii, Hibiscus waimeae ssp. hannerae, Kokia kauaiensis, Labordia tinifolia* var. *wahiawaensis, Myrsine linearifolia, Pritchardia napaliensis, Pritchardia viscosa*) and a minimum of 50 mature individuals per population for short-lived perennials (*Alsinidendron lychnoides, Alsinidendron viscosum, Cyanea recta, Cyanea remyi, Cyrtandra cyaneoides, Delissea rivularis, Phyllostegia knudsenii, Phyllostegia wawrana, Schiedea helleri, Schiedea kauaiensis, Schiedea membranacea, Schiedea stellarioides, Viola kauaiensis* var. *wahiawaensis*).

Downlisting Criteria:
For downlisting, a total of five to seven populations of each taxon should be documented on Kauai where they now occur or occurred historically. Each of these populations must be naturally reproducing, stable or increasing in number, and secure from threats, with a minimum of 100 mature individuals per population for long-lived perennials and a minimum of 300 mature individuals per population for short-lived perennials. Each population should persist at this level for a minimum of 5 consecutive years before downlisting is considered.

Delisting Criteria:

For delisting, a total of 8 to 10 populations of each taxon should be documented on Kauai where they now occur or occurred historically. Each of these populations must be naturally reproducing, stable or increasing in number, and secure from threats, with a minimum of 100 mature individuals per population for long-lived perennials and a minimum of 300 mature individuals per population for short-lived perennials. Each population should persist at this level for a minimum of 5 consecutive years.

Actions Needed:

1. **Protect current populations, control threats and monitor.**
2. **Expand current populations.**
3. **Conduct research essential to conservation of the species.**
4. **Establish new populations as needed to reach recovery objectives.**
5. **Validate and revise recovery criteria.**
6. **Devise and implement a public education program.**

Total Estimated Cost of Recovery ($ 1,000's) * For the Kauai and Kauai II Plant Clusters

Year	Need 1	Need 2	Need 3	Need 4	Need 5	Need 6	Total
1998	76.0	760.0	0.0	0.0	0.0	0.0	836.0
1999	340.5	1,225.0	765.0	150.0	0.0	10.0	2,490.5
2000	1,283.0	1,225.0	765.0	150.0	0.0	10.0	3,433.0
2001	1,383.2	1,636.1	797.0	150.0	0.0	10.0	3,976.3
2002	1,411.5	1,886.1	1,210.1	231.0	0.0	15.4	4,754.1
2003	1,905.4	1,886.1	1,210.1	231.0	0.0	15.4	5,248.0
2004	1,806.3	1,411.9	1,107.3	81.0	0.0	5.4	4,411.9
2005	1,603.3	1,411.9	1,107.3	81.0	0.0	5.4	4,208.9
2006	1,560.6	1,411.9	1,107.3	81.0	0.0	5.4	4,166.2
2007	1,461.5	1,218.5	1,040.7	0.0	0.0	0.0	3,720.7
2008	1,422.6	0.0	1,040.7	0.0	0.0	0.0	2,463.3
2009	1,400.5	0.0	429.9	0.0	0.0	0.0	1,830.4
2010	947.5	0.0	429.9	0.0	0.0	0.0	1,377.4
2011	864.2	0.0	429.9	0.0	0.0	0.0	1,294.1
2012	864.2	0.0	118.5	0.0	0.0	0.0	982.7
2013	633.1	0.0	118.5	0.0	0.0	0.0	751.6
2014	604.2	0.0	118.5	0.0	0.0	0.0	722.7
2015	604.0	0.0	118.5	0.0	184.4	0.0	906.9
2016	604.0	0.0	118.5	0.0	184.4	0.0	906.9
2017	604.0	0.0	118.5	0.0	245.9	0.0	968.4
2018	604.0	0.0	118.5	0.0	61.5	0.0	784.0
2019	604.0	0.0	118.5	0.0	0.0	0.0	722.5
TOTAL	22,587.6	14,072.5	12,388.2	1,155.0	676.2	77.0	50,956.5

*Recovery costs for the taxa in this addendum are based on a ratio of 20/37 from the original estimates of the Recovery Plan for the Kauai Plant Cluster. Original cost estimates were provided by cooperators currently implementing similar actions. Some costs are yet to be determined.

Date of Recovery: To be determined once more is known about the biology and population dynamics of the Kauai II Plant Cluster.

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INTRODUCTION

1. Brief Overview

Much of this section was taken directly from the listing packages covering these taxa (USFWS 1996, 1996a), with minor modifications by the authors based on current status information.

This addendum to the Recovery Plan for the Kauai Plant Cluster (Recovery Plan) covers 20 plant taxa that were added to the Federal list of endangered and threatened species in October of 1996 (61 FR 53070-53089)(Kauai II Plant Cluster). The plants listed as endangered are *Alsinidendron lychnoides* (kuawawaenohu), *Alsinidendron viscosum* (no common name (NCN)), *Cyanea remyi* (haha), *Cyrtandra cyaneoides* (mapele), *Delissea rivularis* (oha), *Hibiscadelphus woodii* (hau kuahiwi), *Hibiscus waimeae* ssp. *hannerae* (koki o keokeo), *Kokia kauaiensis* (kokio), *Labordia tinifolia* var. *wahiawaensis* (kamakahala), *Phyllostegia knudsenii* (NCN), *Phyllostegia wawrana* (NCN), *Pritchardia napaliensis* (loulu), *Pritchardia viscosa* (loulu), *Schiedea helleri* (NCN), *Schiedea kauaiensis* (NCN), *Schiedea membranacea* (NCN), *Schiedea stellarioides* (laulihilihi), and *Viola kauaiensis* var. *wahiawaensis* (nani waialeale). The U.S. Fish and Wildlife Service also determined threatened status for two plants, *Cyanea recta* (haha) and *Myrsine linearifolia* (kolea).

All of the 20 taxa are endemic to the island of Kauai. They are distributed mostly in the northern and northwestern portions of the island and grow in a variety of vegetation communities (shrublands, forests, and mixed communities), elevational zones (lowland to montane), and moisture regimes (dry to wet). Only one species, *Pritchardia napaliensis*, is found in lowland dry communities. The 20 plant taxa and their habitats have been variously affected and are threatened by one or more of the following: habitat degradation and predation by feral or domestic animals (rats, slugs, black-tailed deer, goats and pigs); competition for space, light, water, and nutrients by naturalized, alien vegetation; habitat loss from fires and hurricanes; human recreational activities; and military training exercises. Because of the low numbers of individuals and their severely restricted distributions, populations of these taxa are subject to an increased likelihood of extinction from random naturally occurring events (USFWS 1996).

The Introduction section of this addendum has been constructed in a species-by-species format, allowing the reader to find all information about a particular species in one section. The aim of this effort is to produce a comprehensive analysis of the threats to these taxa as well as a species-by-species analysis of recovery actions needed for stabilization and recovery. As ecosystem management units are identified, multiple populations and species may be managed in a coordinated fashion in order to make recovery actions as efficient as possible.

The Hawaiian Islands (Figure 1), are located over 3,200 kilometers (2,000 miles) from the nearest continent, making them the most isolated high islands on earth. This isolation has allowed the few plants and animals that arrived here to evolve into many varied and highly endemic species. Many of these species have lost their defenses against threats such as mammalian predation and competition with aggressive, weedy plant species that are typical of mainland environments (USFWS 1996).

The objective of this addendum is to provide a framework for the recovery of the Kauai II Plant Cluster so that their protection by the Endangered Species Act (ESA) is no longer necessary. This addendum summarizes available information about each taxon, reviews the threats posed to their continued existence, and lists management actions that are needed to remove these threats. Recovery of these taxa should be pursued via the establishment of management units in order to make the most efficient use of available resources in an effort to conserve not only these taxa but their habitats as well.

Immediate actions necessary to prevent extinction of these taxa include fencing for exclusion of ungulates; alien plant control; protection from fire; population and plant community monitoring and management; *ex situ* propagation; and augmentation of populations, as appropriate. Long-term activities necessary for the perpetuation of these taxa in their natural habitats additionally include baseline and long-term research; public education; maintenance of fenced areas; long-term monitoring and management of populations and communities; and re-establishment of populations within the historic ranges of some taxa. Further research regarding current distribution, reproduction and reproductive status, pollinators, life history, limiting factors, habitat requirements, and minimum viable population sizes is needed to facilitate appropriate management decisions regarding the long-term perpetuation of each of these taxa.

Appendix J contains line drawings of some of the species covered by this addendum. Appendix K contains illustrations of historic and current distributions, and Appendix L provides a summary of land ownership and management for the Kauai II Plant Cluster.

2. General Description of Habitat

See description of island of Kauai on page 5 of the Recovery Plan for the Kauai Plant Cluster and Figure 2.

Most populations of the 20 taxa covered in this addendum are in lowland mesic or wet shrubland or forest communities. Table 1 summarizes the habitat types and associated plant species of the 20 taxa. Lowland dry forests lie between 30 and 1,500 meters (100 and 4,900 feet) elevation and are characterized by an open or closed canopy up to 3 meters (10 feet) tall with little or no herbaceous layer development. These shrublands usually occur in habitats where forests cannot develop, such as on cliffs, ridges, and steep slopes. The annual rainfall of 50 to 200 centimeters (20 to 80 inches) falls primarily during the winter months (USFWS 1996). Lowland mesic forest communities lie between 30 and 1,600 meters (100 and 5,250 feet) elevation and are characterized by a 2 to 20 meters (6.5 to 65 feet) canopy and a diverse understory of shrubs, herbs, and ferns. The annual rainfall of 120 to 380 centimeters (45 to 150 inches) falls predominantly between October and March (USFWS 1996). Lowland mesic forests often grade into lowland wet forests that are typically found on the windward sides of islands or in sheltered leeward situations between 100 and 1,200 meters (330 and 3,940 feet) elevation. The rainfall in this lowland wet community may exceed 500 centimeters (200 inches) per year. These forests were once the predominant vegetation on Kauai but now exist only on steep rocky terrain or cliff faces. The substrate is generally well-drained soils that may support tree canopies up to 40 meters (130 feet) in height (USFWS 1996). The habitat of 8 of the 19 taxa in this addendum extends to the higher elevation montane mesic or wet forests. *Alsinidendron lychnoides*, *Delissea rivularis*, and *Schiedea helleri* are the only taxa found strictly within these montane communities, which typically occur above 910 meters (3,000 feet) elevation (USFWS 1996). The annual rainfall in montane communities may exceed 700 centimeters (280 inches) (USFWS 1996).

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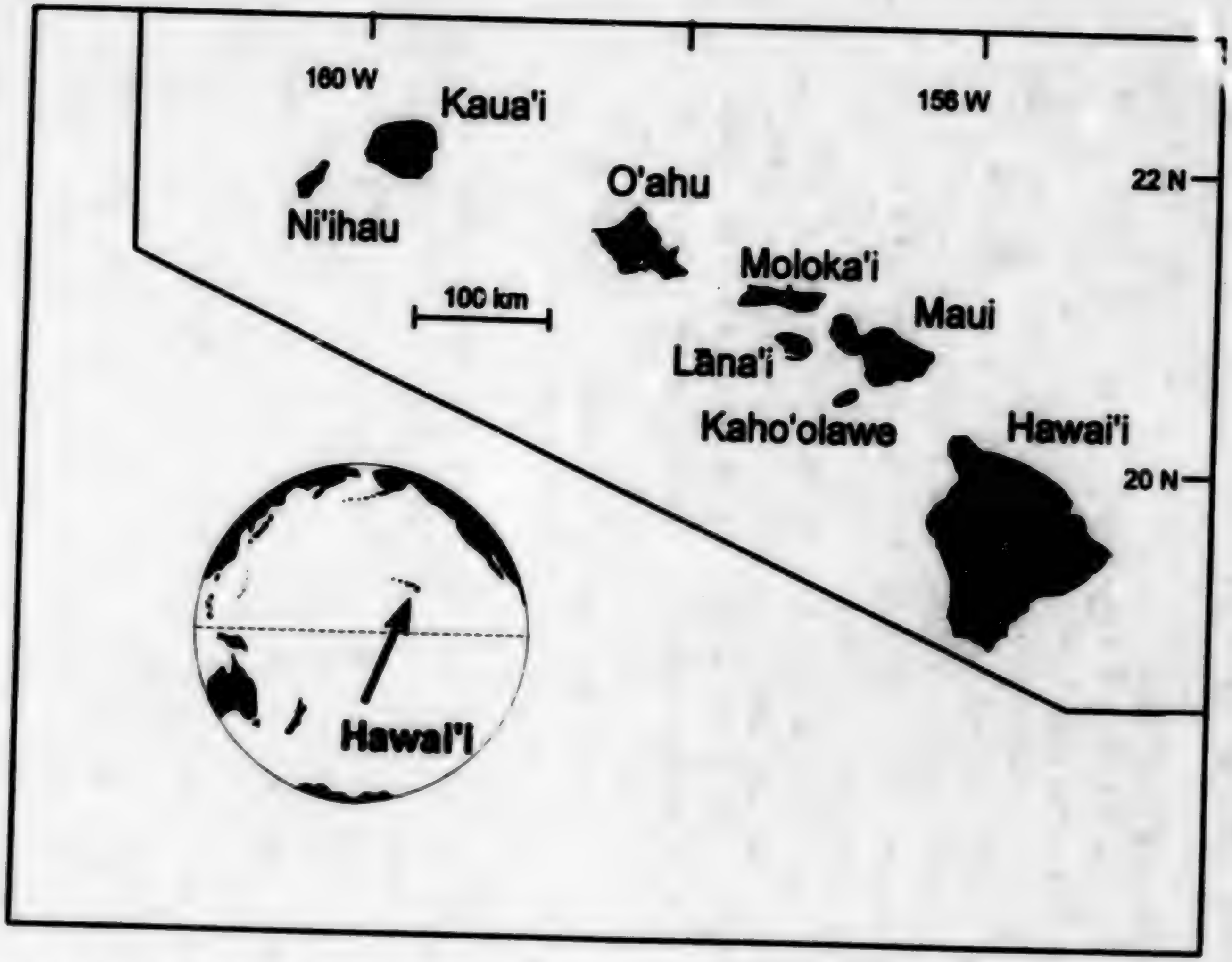

Figure 1. Map of the Main Hawaiian Islands.

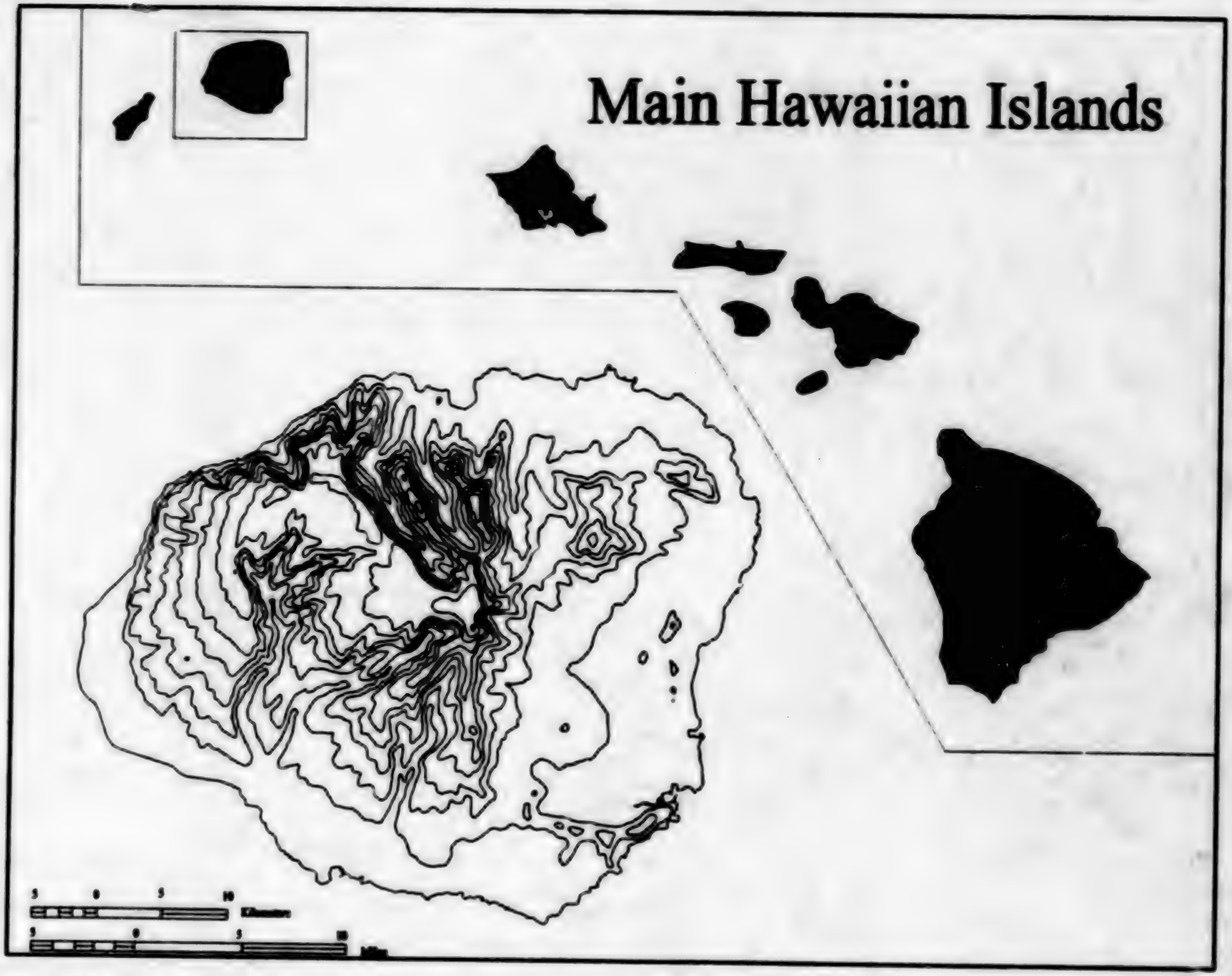

Figure 2. Map of the island of Kauai.

Habitat Type	Kauai II Plant Cluster	Some Associated Native Species	Some Associated Alien Species
Lowland Dry Forest elevation: 30-1,500 meters (100-4,900 feet) rainfall: 50-200 centimeters (20-80 inches) per year	*Pritchardia napaliensis*	*Metrosideros polymorpha* (ohia) *Dicranopteris linearis* (uluhe) *Diospyros sandwicensis* (lama) *Pleomele aurea* (hala pepe) *Pleomele* sp. (hala pepe) *Psychotria* sp. (kopiko) *Cheirodendron trigynum* ('olapa), *Ochrosia* sp. (holei)	*Kalanchoe pinnata* (air plant) *Erigeron karvinskianus* (daisy fleabane) *Lantana camara* (lantana) *Psidium guajava* (guava) *Cordyline fruticosa* (ti)

Table 1. Summary of Kauai II Plant Cluster habitat types and associated plant taxa.

Habitat Type	Kauai II Plant Cluster	Some Associated Native Species	Some Associated Alien Species
Lowland Mesic Forest elevation: 30-1,600 meters (100-5,250 feet) rainfall: 120-380 centimeters (45-150 inches) per year	*Phyllostegia knudsenii* *Phyllostegia wawrana* *Viola kauaiensis* var. *wahiawaensis*	*Broussaisia arguta* (kanawao) *Cheirodendron* sp. (olapa) *Cibotium* sp. (hapuu) *Claoxylon sandwicense* (poola) *Cyrtandra kauaiensis* (ulunahele) *Cyrtandra paludosa* (mea) *Cryptocarya mannii* (holio) *Dicranopteris linearis* (uluhe) *Diplazium sandwichianum* *Diplopterygium pinnatum* (uluhe) *Diospyros sandwicensis* (lama) *Doodia kunthiana* *Dubautia knudsenii* (naenae) *Elaeocarpus bifidus* (kalia) *Elaphoglossum* sp. *Gunnera* sp. *Hedyotis terminalis* (manono) *Machaerina* sp. (uki) *Metrosideros polymorpha* (ohia) *Myrsine* (kolea) *Peperomia* sp. (ala ala wai nui) *Perrottetia sandwicensis* (olomea) *Pittosporum* sp. (hoawa) *Pleomele aurea* (hala pepe) *Pouteria sandwicensis* (alaa) *Pritchardia minor* (loulu) *Psychotria* sp. (kopiko) *Sadleria* sp. (amau) *Scaevola procera* (naupaka kuahiwi) *Selaginella arbuscula* *Syzygium sandwicensis* (ohia ha) *Vaccinium* sp. (ohelo) *Zanthoxylum dipetalum* (ae)	*Rubus rosifolius* (thimbleberry) *Passiflora mollissima* (banana poka) *Rubus argutus* (prickly Florida blackberry) *Melastoma candidum* *Erechtites valerianifolia* (fireweed) *Drymaria cordata* (pipili) *Paspalum conjugatum* (Hilo grass) *Kalanchoe pinnata* (air plant) *Erigeron karvinskianus* (daisy fleabane) *Lantana camara* (lantana) *Juncus planifolius* *Pterolepis glomerata*

Table 1. Continued.

Habitat Type	Kauai II Plant Cluster	Some Associated Native Species	Some Associated Alien Species
Lowland Wet Forest elevation: 100-1,200 meters (330-3,940 feet) rainfall: may exceed 500 centimeters (200 inches) per year	*Alsinidendron viscosum* *Cyanea recta* *Cyanea remyi* *Hibiscus waimeae ssp. hannerae* *Labordia tinifolia* var. *wahiawaensis* *Myrsine linearifolia* *Pritchardia viscosa*	*Acacia koa* (koa) *Alyxia oliviformis* (maile) *Antidesma* sp. (hame) *Athyrium* sp. *Bobea* sp. (ahakea) *Broussaisia arguta* (kanawao) *Carex* sp. *Charpentiera elliptica* (papala) *Cheirodendron* (olapa) *Cheirodendron platyphyllum* (lapalapa). *Cibotium* sp. (hapuu) *Cyanea hirtella* (haha) *Cyrtandra* sp. (haiwale) *Dicranopteris linearis* (uluhe) *Diplazium* sp. *Dodonaea viscosa* (aalii) *Eurya sandwicensis* (anini) *Freycinetia arborea* (ieie) *Hedyotis terminalis* (manono) *Ilex anomala* (aiea) *Lysimachia* sp. *Melicope* sp. (alani) *Metrosideros polymorpha* (ohia) *Perrottetia sandwicensis* (olomea) *Pipturus* sp. (mamaki) *Pisonia* sp. (papala kepau) *Pleomele* sp. (hala pepe) *Psychotria* sp. (kopiko) *Sadleria* sp. (amau) *Syzygium* sp.	*Aleurites moluccana* (kukui) *Rubus rosifolius* (thimbleberry) *Rubus argutus* (prickly Florida blackberry) *Blechnum occidentale* (blechnum fern) *Clidemia hirta* (Koster's curse) *Crassocephalum crepidioides* *Deparia petersenii* *Melastoma candidum* *Erechtites valerianifolia* (fireweed) *Paspalum conjugatum* (Hilo grass) *Kalanchoe pinnata* (air plant) *Erigeron karvinskianus* (daisy fleabane) *Lantana camara* (lantana) *Psidium* sp. (guava) *Cordyline fruticosa* (ti) *Sacciolepis indica* (Glenwood grass) *Youngia japonica* (Oriental hawksbeard) *Melinis minutiflora* (molasses grass)

Table 1. Continued.

Habitat Type	Kauai II Plant Cluster	Some Associated Native Species	Some Associated Alien Species
Montane Wet Forest elevation: above 900-2,200 meters (3,000-7,200 feet) elevation rainfall: may exceed 250-700 centimeters (100-280 inches) per year	*Alsinidendron lychnoides* *Cyrtandra cyaneoides* *Delissea rivularis* *Schiedea helleri* *Schiedea kauaiensis* *Schiedea membranacea*	*Athyrium* sp. *Astelia* sp. (painiu) *Boehmeria grandis* (akolea) *Broussaisia arguta* (kanawao) *Carex* sp. *Cibotium* sp. (hapuu) *Cheirodendron* sp. (olapa) *Coprosma* sp. (pilo) *Cyanea hirtella* (haha) *Cyrtandra* sp. (haiwale) *Dianella sandwicensis* (uki uki) *Dicranopteris linearis* (uluhe) *Diospyros sandwicensis* (lama) *Euphorbia haeleeleana* (akoko) *Exocarpus luteolus* (heau) *Hedyotis terminalis* (manono) *Machaerina* sp. (uki) *Metrosideros polymorpha* (ohia) *Peperomia* sp. (ala ala wai nui) *Peucedanum sandwicense* (makou) *Pipturus* sp. (mamaki) *Poa sandwicensis* *Psychotria hexandra* (kopiko) *Sadleria* sp. (amau) *Vaccinium* sp. (ohelo) *Viola wailenalenae*	*Ageratina riparia* (Hamakua pamakani) *Rubus rosifolius* (thimbleberry) *Passiflora mollissima* (banana poka) *Rubus argutus* (prickly Florida blackberry) *Deparia petersenii* *Drymaria cordata* (pipili) *Paspalum conjugatum* (Hilo grass) *Erigeron karvinskianus* (daisy fleabane) *Lantana camara* (lantana) *Psidium cattleianum* (strawberry guava)

Table 1. Continued.

Habitat Type	Kauai II PlantCluster	Some Associated Native Species	Some Associated Alien Species
Montane Mesic Forest elevation: above 500-2,700 meters (1,600-8,900 feet) elevation rainfall: may exceed 100-130 centimeters (40-50 inches) per year	*Hibiscadelphus woodii* (hau kuahiwi) *Kokia kauaiensis* (kokio) *Schiedea stellarioides*	*Acacia koa* (koa) *Bidens cosmoides* (poola ai) *Bobea* sp. (ahakea) *Chamaesyce* sp. (akoko) *Charpentiera elliptica* (papala) *Dianella sandwicensis* (uki uki) *Diospyros sandwicensis* (lama) *Dodonaea viscosa* (aalii) *Dubautia* sp. (naenae) *Hedyotis terminalis* (manono) *Lepidium serra* (anaunau) *Lipochaeta* sp. (nehe) *Lobelia niihauensis* *Lysimachia* sp. *Mariscus* sp. *Melicope* sp. (alani) *Metrosideros polymorpha* (ohia) *Myrsine* sp. (kolea) *Nestegis sandwicensis* (olopua) *Nototrichium divaricatum* n. *sandwicense* (kului) *Pleomele* sp. (hala pepe) *Poa mannii* *Stenogyne campanulata* *Styphelia tameiameiae* (pukiawe)	*Rubus rosifolius* (thimbleberry) *Kalanchoe pinnata* (air plant) *Passiflora ligularis* (sweet granadilla), *Rubus argutus* (prickly Florida blackberry) *Psidium cattleianum* (strawberry guava) *Erigeron karvinskianus* (daisy fleabane) *Triumfetta semitriloba* (Sacramento bur) *Melinis minutiflora* (molasses grass) *Lantana camara* (lantana)

Table 1. Continued.

Eighteen of the 20 taxa included in this addendum are located on State of Hawaii lands (including State parks, forest reserves, and natural area reserves). Land stewardship of current populations are included below (USFWS 1996).

Table 2. Land stewards of current populations of the Kauai II Plant Cluster taxa. Asterisk indicates associated comments. None of these taxa occur on Federal land.

Taxon	Total Populations and (Individuals)	Populations by Land Steward					Comments
		SL	SP	NAR	WP	Private	
Alsinidendron lychnoides	4, (50-100)	✓	✓	✓	✓		
Alsinidendron viscosum	4, (100)	✓	✓		✓		
Cyanea recta	7, (1,000-1,500)	✓				✓	
Cyanea remyi	5, (500)	✓				✓	
Cyrtandra cyaneoides	5, (550-1,220)	✓				✓	
Delissea rivularis	3, (35-40)	✓*		✓			*One population may be extinct
Hibiscadelphus woodii	1, (4)		✓				
Hibiscadelphus waimeae ssp. *hannerae*	2, (75-125)	✓				✓	
Kokia kauaiensis	6, (105-150)	✓	✓		✓		
Labordia tinifolia var. *wahiawaensis*	1, (20-30)					✓	
Myrsine linearifolia	8, (1,000-1,500)	✓				✓	
Phyllostegia knudsenii	1, (3)	✓					
Phyllostegia wawrana	3, (45-55)	✓					
Pritchardia napaliensis	3, (fewer than 90)	✓	✓	✓			
Pritchardia viscosa	1, (4)	✓					
Schiedea helleri	3, (43-53)	✓			✓		
Schiedea kauaiensis	2, (15)		✓	✓			
Schiedea membranacea	6, (200-250)	✓	✓	✓		✓	
Schiedea stellarioides	1, (500-1,000)	✓					
Viola kauaiensis var. *wahiawaensis*	1, (fewer than 100)					✓	

Key: SL - State Land unspecified; SP - State Park; NAR - Natural Area Reserve; WP - Wilderness Preserve.

3. Overall Reasons for Decline and Current Threats

A general discussion of threats to the native communities upon which the Kauai II Plant Cluster taxa depend is located in section C, beginning on page 9, of the Recovery Plan for the Kauai Plant Cluster. Threats specific to each taxon are detailed in the species accounts and summarized in Table 3.

Table 3. Summary of threats to the Kauai II Plant Cluster taxa

Species	Alien Species	Low Numbers	Natural Disasters	Human Impacts
Alsinidendron lychnoides	P, Pl	X	X	X
Alsinidendron viscosum	G, P, Pl	X	X	(X)
Cyanea recta	G, P, R, Pl, S		X	(X)
Cyanea remyi	G, P, R, Pl, S	X	X	
Cyrtandra cyaneoides	Pl, P, R	X	X	
Delissea rivularis	P, Pl, R	X	X	
Hibiscadelphus woodii	G, P, Pl, B	X	X	
Hibiscus waimeae ssp. *hannerae*	P, Pl	X	X	
Kokia kauaiensis	G, D, R, Pl		X	
Labordia tinifolia var. *wahiawaensis*	P, Pl	X	X	X
Myrsine linearifolia	G, P, Pl			
Phyllostegia knudsenii	G, P, Pl	X	X	
Phyllostegia wawrana	P, Pl	X		
Pritchardia napaliensis	G, P, R, Pl	X	X	
Pritchardia viscosa	R, Pl	X	X	X
Schiedea helleri	(P), Pl	X	X	
Schiedea kauaiensis	G, P, D, Pl, S, F	X	X	
Schiedea membranacea	G, D, P, Pl		X	
Schiedea stellarioides	G, P, Pl	X	X	
Viola kauaiensis var. *wahiawaensis*	P, Pl	X	X	X

Key: D - deer, G - goats, S - slugs, P - pigs, R - rats, Pl - plants, B - birds, F - fire
() - potential threat.

4. Overall Conservation Efforts

Federal and State

The taxa covered in this addendum were added to the Federal list of endangered and threatened species on October 10, 1996; 18 as endangered and 2 as threatened (*Cyanea recta* and *Myrsine linearifolia*).

The Federal listing of the taxa in the Kauai II Plant Cluster as endangered or threatened has afforded each the protection of the Endangered Species Act (ESA). When a species is listed as endangered or threatened under this law, it is automatically added to the State of Hawaii's list of protected species (Hawaii Revised Statutes Chapter [HRS] 195D). Hawaii State law prohibits taking of endangered flora and encourages conservation by State government agencies. ("Take" as defined by Hawaii State law means "to harass, harm..., wound, kill..., or collect endangered or threatened... species... or to cut, collect, uproot, destroy, injure, or possess endangered or threatened... species of... land plants, or to attempt to engage in any such conduct" [HRS 195D].) The Endangered Species Act offers additional Federal protection to these taxa since it is a violation of the Act for any person to remove, cut, dig up, or damage or destroy an endangered plant in an area not under Federal jurisdiction in knowing violation of any State law or regulation or in the course of any violation of a State criminal trespass law [section 9(a)(2) of the Endangered Species Act].

Critical habitat was not designated for any of the taxa in the Kauai II Plant Cluster. Designation was not deemed prudent because of the possible increased threat to the plants by vandalism, researchers, curiosity seekers, or collectors of rare plants due to the mandated publication of precise maps and descriptions of critical habitat in local newspapers. Also, designation of critical habitat would provide no benefits beyond those that these species would receive by virtue of their being listed as endangered or threatened (USFWS 1996).

The State Division of Forestry and Wildlife (DOFAW) and the U.S. Fish and Wildlife Service are working together to prevent imminent extinctions on Kauai. Two of these taxa, *Alsinidendron viscosum* and *Schiedea stellarioides*, are scheduled for spot fencing in 1998 to protect them from goats [Marie Bruegmann, U.S. Fish and Wildlife Service, personal communication 1997].

In 1994, the Hawaii Department of Agriculture released a leaf-eating insect, *Lius poseidon*, a member of the flat-headed wood-borer family

(Buprestidae), as a biological control agent in an attempt to control the invasive alien plant, Koster's curse (*Clidemia hirta*) (USFWS 1996). In 1995, the Hawaii Department of Agriculture began releasing the leaf-feeding insect *Antiblemma acclinalis* (*Lepidoptera*: *Noctuidae*) as an additional biological control effort to control Koster's curse on Kauai. Periodic releases are ongoing (Myron Isherwood, Hawaii Department of Agriculture, personal communication 1997).

One population of *Pritchardia napaliensis* in the Hono O Na Pali Natural Area Reserve (NAR) and one population of *Kokia kauaiensis* in Paaiki Valley have been fenced by the Kauai Division of Forestry and Wildlife (Alvin Kyono, Kauai Division of Forestry and Wildlife, personal communication 1997).

Private

Seeds or plants of 18 of these taxa have been collected by botanical gardens (Gary Ray, formerly with the Center for Plant Conservation (CPC), personal communication 1997). However, the viability of seeds in storage is likely to be minimal, since many Hawaiian plants have seeds that do not store well under standard storage methods. Tests are currently being done by the United States Department of Agriculture (USDA) National Seed Storage Laboratory on *Alsinidendron lychnoides* and *Alsinidendron viscosum*, along with dozens of other species, to determine if cryopreservation (low temperatures) will be a more successful method of storage (C. Walters, personal communication 1998). Ten of the Kauai II Plant Cluster taxa have been successfully propagated in botanical gardens (Table 4). For three taxa, *Schiedea helleri*, *Schiedea kauaiensis* and *Viola kauaiensis* var. *wahiawaensis*, there are no collections of seeds, tissue, or plants in any botanical gardens.

Table 4. Seeds, cultures and plants of the Kauai II Plant Cluster in storage or propagation at botanical gardens. NTBG = National Tropical Botanical Garden. LA = Lyon Arboretum. WA = Waimea Arboretum

Taxon	Seed accessions / total number of seeds in storage			Tissue accessions / total number of cultures			Plants in nursery			Plants planted on grounds		
	NTBG	LA	WA	NTBG	LA	WA	NTBG	LA	WA	NTBG	LA	WA
Alsinidendron lychnoides	8 / 44,000											
Alsinidendron viscosum	8 / 5,222				20 / 229							
Cyanea recta	3 / 915											
Cyanea remyi	2 / 1102											
Cyrtandra cyaneoides	2 / 1300											
Delissea rivularis	3 / 800				4 / 24			15				
Hibiscadelphus woodii					4 / 12							
Hibiscadelphus waimeae ssp. hannerae									1	26		
Kokia kauaiensis		1 / 65	1 / 25		2 / 2			4	13	43	3	14

Table 4. Seeds, cultures and plants of the Kauai II Plant Cluster in storage or propagation at botanical gardens. NTBG = National Tropical Botanical Garden. LA = Lyon Arboretum. WA = Waimea Arboretum

Taxon	**Seed accessions / total number of seeds in storage**			**Tissue accessions / total number of cultures**			**Plants in nursery**			**Plants planted on grounds**		
	NTBG	**LA**	**WA**	**NTBG**	**LA**	**WA**	**NTBG**	**LA**	**WA**	**NTBG**	**LA**	**WA**
Labordia tinifolia* var. *wahiawaensis	3 / 1,140						4	27				
Myrsine linearifolia	3 / 117				2 / 7					2		
Phyllostegia knudsenii	1 / 1											
Phyllostegia wawrana	3 / 300						1					
Pritchardia napaliensis								2		16		
Pritchardia viscosa					3 / 98		13			5		2
Schiedea helleri	0*			0*								
Schiedea kauaiensis												
Schiedea membranacea	5 / 9,735								3	18		
Schiedea stellarioides	2 / 1,870						4					
Viola kauaiensis* var. *wahiawaensis												

*** indicates that specimens were collected but did not survive.**

5. Species Accounts

The following are individual species accounts for the Kauai II Plant Cluster taxa. The general strategy for the recovery of these species can be found in the Overall Recovery Strategy section, immediately following the Species Accounts section. Species-specific recovery actions can be found in the account for that species.

Alsinidendron lychnoides Recovery Priority 2

(on USFWS scale of 1-18 (USFWS 1983) - See Appendix G of the Recovery Plan for the Kauai Plant Cluster.

Description and Taxonomy

Appendix J contains a line drawing of this taxon.

Alsinidendron lychnoides was first described by Wilhelm Hillebrand as *Schiedea lychnoides* based on a specimen collected by Valdemar Knudsen (between about 1853 and 1871) above Waimea, Kauai. While both Hillebrand and Amos A. Heller believed that there were good reasons to place *Schiedea lychnoides* in the genus *Alsinidendron*, it wasn't until 1944 that Earl E. Sherff transferred the species to this genus (USFWS 1996).

Alsinidendron lychnoides, a member of the pink family (Caryophyllaceae), is a weakly climbing or sprawling subshrub. The main stems are 0.4 to 3 meters (1.3 to 9.8 feet) long with short side branches. The plant is woody, at least at the base, and densely covered with fine glandular hairs throughout. The thin leaves are egg-shaped to elliptic and are 3.5 to 6.5 centimeters (1.4 to 2.6 inches) long and 1.5 to 3.8 centimeters (0.6 to 1.5 inches) wide. Eighteen to 21 flowers are arranged in clusters with stalks ranging from 2 to 2.4 centimeters (0.8 to 0.9 inch) long. The four sepals are white and thin, and remain so at maturity. The outer two sepals greatly overlap the inner ones. The sepals are oblong-ovate, 10 to 12 millimeters (0.4 to 0.5 inch) long, but enlarge to 12 to 16 millimeters (0.5 to 0.6 inch) long in fruit, completely enclosing the fruit at maturity. The stamens are scarcely fused at the base with basal outgrowths 2.5 to 3.5 millimeters (0.1 inch) long, nearly as wide, and two- to three-toothed. The fruit are egg-shaped capsules, 9 to 12 millimeters (0.4 to 0.5 inch) long, with 8 to 11 valves. The black seeds are approximately 1 millimeter (0.04 inch) long with low transverse ridges on the surface. This species is distinguished from others in this endemic Hawaiian genus by the weakly climbing or sprawling habit, color of the sepals, number of flowers per cluster, and size of the leaves. *Alsinidendron lychnoides* is closely related to *Alsinidendron viscosum*, which differs primarily in having narrower leaves, fewer capsule valves, and fewer flowers per cluster (USFWS 1996).

Life History

Alsinidendron lychnoides was observed with fruits during February 1995 (Steve Perlman, National Tropical Botanical Garden (NTBG), Provenance Report 1995). No additional life history information for this species is currently available.

Habitat Description

Alsinidendron lychnoides typically grows in montane wet forest dominated by *Metrosideros polymorpha* (ohia) and *Cheirodendron* sp. (olapa), or by ohia and *Dicranopteris linearis* (uluhe), trailing on the ground or on other vegetation, and at elevations between 1,100 and 1,320 meters (3,600 and 4,330 feet). Associated plant species include *Athyrium* sp., *Carex* sp., *Cyrtandra* sp. (haiwale), *Machaerina* sp. (uki), *Vaccinium* sp. (ohelo), *Peperomia* sp. (ala ala wai nui), *Hedyotis terminalis* (manono), *Astelia* sp. (painiu), and *Broussaisia arguta* (kanawao) (USFWS 1996).

Historic and Current Ranges and Population Status (Appendix K-2)

Historically, *Alsinidendron lychnoides* has been found on the east rim of Kalalau Valley near Keanapuka, the western and southeastern margins of the Alakai Swamp, and southwest of the Swamp near Kaholuamano on the island of Kauai. This species is extant on State-owned land in the Alakai Swamp, including the Alakai Wilderness Preserve, and on State-owned land on the west and east rims of Kalalau Valley. This latter population occurs on the boundary of Hono O Na Pali Natural Area Reserve and Na Pali Coast State Park. The 4 known populations contain between 50 and 100 plants total (USFWS 1996).

Reasons for Decline and Current Threats

The major threats to *Alsinidendron lychnoides* are competition from the aggressive alien plant species *Rubus argutus* (prickly Florida blackberry), habitat degradation by feral pigs (*Sus scrofa*), and trampling by humans. This species is also threatened by a risk of extinction from naturally occurring events (such as landslides or hurricanes) and by reduced reproductive vigor due to the small number of extant individuals (USFWS 1996). One plant in Kalalau Valley has died since Hurricane Iniki struck Kauai in September 1992, probably as a result of a landslide caused by hurricane-denuded slopes (Ken Wood and S. Perlman, NTBG, personal communication 1997).

Conservation Measures

Wild seeds were collected on the trail between Pihea and Alakai Swamp Trail in February 1995 (S. Perlman, NTBG, Provenance Report 1995). Currently, over 40,000 seeds are in storage at the National Tropical Botanical Garden (G. Ray, personal communication 1997), but the viability of those seeds is likely to be low. The U.S. Department of Agriculture National Seed Storage Laboratory is currently testing this species for potential cryopreservation as a method of long-term storage (C. Walters, personal communication 1998). No additional species-specific conservation efforts have been undertaken. General conservation efforts for the Kauai II Plant Cluster taxa can be found in the Overall Conservation Efforts section of this addendum.

Needed Recovery Actions

1) Maintenance of adequate genetic stock.

In order to prevent this taxon from going extinct, propagation efforts and the maintenance of adequate genetic stock *ex situ* should be continued. Additional wild seeds should be collected periodically until the cryopreservation method of long-term storage is perfected. This will insure that viable seed stock is available for out planting.

2) Construct enclosures on State lands in the Alakai Swamp and west and east rims of Kalalau Valley.

Without this protection, this species will continue to decline due to degradation of habitat by feral pigs. Once enclosed, those areas should undergo management to remove alien plant species, like the prickly Florida blackberry, which have been predominantly spread by feral pigs.

3) Reduce potential trampling by humans.

Completion of the Alakai Wilderness Preserve board walk will help reduce potential trampling by humans as well as reduce the spread of alien plants by limiting the amount of area impacted by humans.

Additional recovery actions, as discussed in the Stepdown Narrative of the Recovery Plan for the Kauai Plant Cluster, beginning on page 138 of the Plan, are also appropriate for this species.

Alsinidendron viscosum Recovery Priority 2

(on USFWS scale of 1-18 (USFWS 1983) - See Appendix G of the Recovery Plan for the Kauai Plant Cluster.

Description and Taxonomy

No line drawing is available for *Alsinidendron viscosum*.

Horace Mann, Jr., originally described *Alsinidendron viscosum* as *Schiedea viscosa* based on a collection he made with William T. Brigham (between 1864 and 1865) on Kauai. He chose the specific name in reference to the sticky hairs covering the whole plant. Later, Sherff placed the taxon in the genus *Alsinidendron* based on a reassessment of this species and *Schiedea lychnoides*, as suggested by Hillebrand and Heller (USFWS 1996).

Alsinidendron viscosum, a member of the pink family, is a weakly climbing or sprawling subshrub. The stems are 0.6 to 3 meters (2.0 to 9.8 feet) long, and densely covered with fine glandular hairs throughout. The thin and membranous leaves are narrowly elliptic and are 2.5 to 5 centimeters (1.0 to 2.0 inches) long and 0.8 to 1.8 centimeters (0.3 to 0.7 inch) wide. Usually three to nine flowers are arranged in loose clusters with stalks ranging from 2 to 3.5 centimeters (0.8 to 1.4 inches) long. The four sepals are white, thin, and membranous, and remain so at maturity. The outer two sepals greatly overlap the inner ones. The sepals are oblong in shape and 8 to 9 millimeters (0.3 inch) long, but enlarge to approximately 12 millimeters (0.5 inch) long in fruit, completely enclosing the fruit at maturity. The stamens are scarcely fused at the base and the basal outgrowths are about 3 millimeters (0.1 inch) long, nearly as wide, and two-toothed. The fruits are egg-shaped capsules, 8 to 12 millimeters (0.3 to 0.5

inch) long, and opening by five to seven valves. The seeds are dark reddish brown, and approximately 0.8 millimeter (0.03 inch) long with a minutely hairy surface. This species is distinguished from others in this endemic Hawaiian genus by the weakly climbing or sprawling habit, color of the sepals, number of flowers per cluster, and size of the leaves. *Alsinidendron viscosum* is closely related to *Alsinidendron lychnoides*, which differs primarily in having wider leaves and more capsule valves and flowers per cluster (USFWS 1996).

Life History

Alsinidendron viscosum was observed in flower during January, February, and April 1995 (S. Perlman, NTBG, Provenance Report 1995). No additional life history information for this species is currently available.

Habitat Description

Alsinidendron viscosum is typically found at elevations between 820 and 1,070 meters (2,700 and 3,510 feet), on steep slopes in *Acacia koa* (koa)-ohia lowland mesic or wet forest. Associated plant species include *Alyxia oliviformis* (maile), *Bobea* sp. (ahakea), *Carex* sp., *Dodonaea viscosa* (aalii), *Ilex anomala* (aiea), *Melicope* sp. (alani), *Pleomele* sp. (hala pepe), and *Psychotria* sp. (kopiko) (USFWS 1996).

Historic and Current Ranges and Population Status (Appendix K-3)

Historically, *Alsinidendron viscosum* was found at the Kaholuamano, Kokee, Halemanu, Nawaimaka, and Waialae areas of northwestern Kauai (USFWS 1996). This species had not been seen since Forbes' 1917 collection near Kauaikinana in Kokee when, in 1991, Steven Perlman and Kenneth Wood of Hawaii Plant Conservation Center (HPCC) at the National Tropical Botanical Garden discovered a population of 11 mature plants on the ridge between Waialae and Nawaimaka valleys. In 1993, another 20 to 30 plants were discovered in the same general area on a north-facing ridge in Nawaimaka Valley. In 1992, Timothy Flynn and David Lorence of the National Tropical Botanical Garden located 10 plants along the Mohihi-Waialae Trail. In 1996, John Plews discovered a population of about 50 plants along the Ditch Trail in the Kokee area (John Plews, personal communication 1997).

The 4 populations (1 population in Nawaimaka Valley, 1 population on Waialae Ridge, 1 population along Ditch Trail, and 1 population on Mohihi-Waialae Trail) total about 100 mature plants on State-owned land. One population is within the Alakai Wilderness Preserve (USFWS 1996) and one population is in Kokee State Park (J. Plews, personal communication 1997).

Reasons for Decline and Current Threats

Destruction of habitat by feral pigs and goats (*Capra hircus*); competition with the alien plant species prickly Florida blackberry, *Lantana camara* (lantana), and *Melinis minutiflora* (molasses grass); and a risk of extinction from naturally occurring events and from reduced reproductive vigor, due to the small number of extant populations and individuals, are the major threats to *Alsinidendron viscosum* (USFWS 1996).

Conservation Measures

The Division of Forestry and Wildlife and the U.S. Fish and Wildlife Service intend to fence the Nawaikama population of this species in 1998 to protect it from imminent destruction by goats (M. Bruegmann, personal communication 1997). Over 5,000 seeds are in storage at the National Tropical Botanical Garden (G. Ray, personal communication 1997). However, seed germination tests indicate less than 1 percent germination of these seeds after only 1 year in storage (NTBG 1992). The U.S. Department of Agriculture National Seed Storage Laboratory is currently testing this species for potential cryopreservation as a method of long-term storage (C. Walters, personal commurication 1998). Lyon Arboretum is propagating this species by tissue culture (G. Ray, personal communication 1997). Tissue culture is a method of sprouting roots and shoots from meristematic tissue by placing the tissue on a medium and applying a growth hormone. No additional species-specific conservation efforts have been undertaken. General conservation efforts for the Kauai II Plant Cluster taxa can be found in the Overall Conservation Efforts section of this plan.

Needed Recovery Actions

1) Remove alien plants inside completed enclosures.

The U.S. Fish and Wildlife Service intends to fence the Nawaikama population in 1998 to protect it from imminent destruction by goats. Once enclosed, this area should be surveyed and managed to reduce threats from the following plant species: prickly Florida blackberry, lantana, and molasses grass.

2) Construct additional enclosures.

Additional enclosures should be constructed around the Waialae Ridge population, the Ditch Trail population and the Mohihi-Waialae Trail population. Once enclosed, those areas should undergo management to remove alien plants.

3) Maintenance of adequate genetic stock.

In order to prevent this taxon from going extinct, propagation efforts and the maintenance of adequate genetic stock *ex situ* should be continued. Additional wild seeds should be collected periodically until the cryopreservation method of long-term storage is perfected. This will insure that viable seed stock is available for outplanting.

4) Outplanting in protected areas.

Ongoing monitoring in those areas that are fenced should be used to determine the most appropriate outplanting sites in the future. Outplanting in these areas can boost population numbers to reduce risk of extinction from naturally occurring events or from reduced reproductive vigor, due to the small numbers of extant populations and individuals.

Additional recovery actions, as discussed in the Stepdown Narrative of the Recovery Plan for the Kauai Plant Cluster, beginning on page 138 of the Plan, are also appropriate for this species.

Cyanea recta Recovery Priority 2

(on USFWS scale of 1-18 (USFWS 1983) - See Appendix G of the Recovery Plan for the Kauai Plant Cluster.

Description and Taxonomy

No line drawing is available for *Cyanea recta*.

While a member of the Austrian East Asiatic Exploring Expedition, Dr. Heinrich Wawra collected a new lobelioid on Kauai, which he later described and named *Delissea recta*. In 1888, Hillebrand transferred this species to the genus *Cyanea*, and this is the name accepted in the current treatment of the family. Other published names, which Lammers consider to be synonymous with *Cyanea recta*, include *Cyanea larrisonii*, *Cyanea rockii*, *Cyanea salicina*, *Delissea larrisonii*, and *Delissea rockii* (USFWS 1996).

Cyanea recta, a member of the bellflower family, is an unbranched shrub 1 to 1.5 meters (3.3 to 4.9 feet) tall. The narrowly elliptic leaves are 12 to 28 centimeters (4.7 to 11 inches) long and 1.2 to 5 centimeters (0.5 to 2 inches) wide, with minutely toothed margins. The upper surface is green and smooth, while the lower surface is whitish green to pale green, and smooth or hairy. Five to seven flowers are arranged on an inflorescence stalk 7 to 10 centimeters (3 to 4 inches) long, each having an individual stalk 5 to 17 millimeters (0.2 to 0.7 inch) in length. The densely hairy flowers are purple or white with purple longitudinal stripes, 30 to 40 millimeters (1.2 to 1.6 inches) long, and 3 to 4 millimeters (0.1 to 0.2 inch) wide, with spreading lobes. The staminal column is smooth or sparsely hairy at the base. The anthers are covered with minute epidermal projections, the lower two with tufts of white hairs at the tip. The fruit is an egg-shaped, purple berry. *Cyanea recta* is distinguished from other species in the genus that grow on Kauai by the following collective characteristics: horizontal or ascending inflorescence, narrowly elliptic leaves 12 to 28 centimeters (4.7 to 11 inches) long, flat leaf margins, and purple berries (USFWS 1996).

Life History

No life history information for this species is currently available.

Habitat Description

Cyanea recta grows in lowland wet or mesic ohia forest or shrubland, usually in gulches or on slopes, and typically from 400 to 940 meters (1,300 to 3,070 feet) elevation. Associated plant species include kopiko, *Antidesma* sp. (hame), *Cheirodendron platyphyllum* (lapalapa), *Cibotium* sp. (hapuu), and *Diplazium* sp. (USFWS 1996).

Historic and Current Ranges and Population Status (Appendix K-4)

Historically, *Cyanea recta* was found at scattered locations in northeastern and central Kauai, including upper Hanalei Valley, Waioli Valley, Hanapepe Valley, Kalalau cliffs, Wainiha Valley, Makaleha Mountains, Limahuli Valley, Powerline Trail, and the Lehua Makanoe-Alakai area. Currently, 7 populations of this species, totalling approximately 1,000 to 1,500 individuals, are found on State and private land in the following areas: upper Waioli Valley, with more than 150 plants; Wainiha Valley, with several hundreds of plants; Makaleha Mountains, with an estimated 123 plants; Limahuli Valley with fewer than 50 plants; and the Wahiawa Bog area, Iliiliula drainage; and the back of Hanalei Valley with an unknown numbers of plants (USFWS 1996).

Reasons for Decline and Current Threats

The major threats to *Cyanea recta* are bark removal and other damage by rats; habitat degradation by feral pigs; browsing by goats; unidentified slugs that feed on the stems; and competition with the alien plant species *Blechnum occidentale* (blechnum fern), lantana, *Rubus rosifolius* (thimbleberry), *Clidemia hirta* (Koster's curse), *Crassocephalum crepidioides*, *Deparia petersenii*, *Erechtites valerianifolia* (fireweed), *Melastoma candidum*, *Paspalum conjugatum* (Hilo grass), *Sacciolepis indica* (Glenwood grass), and *Youngia japonica* (Oriental hawksbeard) (K. Wood and S. Perlman, NTBG, personal communication 1997).

Conservation Measures

The National Tropical Botanical Garden has collected and is storing seeds of this species (G. Ray, personal communication 1997). No additional species-specific conservation efforts have been undertaken. General conservation efforts for the Kauai II Plant Cluster taxa can be found in the Overall Conservation Efforts section of this plan.

Needed Recovery Actions

1) Reduce threats from rodent and slug predation.

A management plan to control rats should be developed. This should include the use of the currently approved Diphacinone bait blocks and ultimately a more broad-scale method such as aerial dispersal of rodenticide. Methods to control slug predation on this species need to be determined and carried out.

2) Construct enclosures to protect against feral ungulates.

Enclosures on both State and private land should be constructed to reduce impacts from feral ungulates. Because some of the land is privately owned a commitment should be developed for long-term stewardship and conservation of these areas once they have been enclosed.

3) Maintenance of adequate genetic stock.

In order to prevent this taxon from going extinct, propagation efforts and the maintenance of adequate genetic stock *ex situ* should be continued. Additional wild seeds should be collected periodically until the cryopreservation method of long-term storage is perfected. This will insure that viable seed stock is available for outplanting.

Additional recovery actions, as discussed in the Stepdown Narrative of the Recovery Plan for the Kauai Plant Cluster, beginning on page 138 of the Plan, are also appropriate for this species.

Cyanea remyi Recovery Priority 2

(on USFWS scale of 1-18 (USFWS 1983) - See Appendix G of the Recovery Plan for the Kauai Plant Cluster.

Description and Taxonomy

Appendix J contains a line drawing of this taxon.

The French naturalist and ethnologist Ezechiel Jules Remy first collected *Cyanea remyi* on Kauai or Niihau between 1851 and 1855. The specimen, labeled as an unidentified *Delissea*, languished in the herbarium of the Natural History Museum in Paris until Joseph F. Rock formally described it and named it in honor of the collector in 1917. Lammers & Lorence (1993) surmised that the taxon may be synonymous with *Cyanea truncata* due, at that time, to the inadequate material available for study. However, several recent collections by botanists from the

National Tropical Botanical Garden have confirmed the distinctness of this species (USFWS 1996).

Cyanea remyi, a member of the bellflower family, is a shrub 0.9 to 2 meters (3 to 6.6 feet) tall with generally unbranched stems 1 to 2.5 centimeters (0.4 to 1 inch) in diameter. The stems are erect, unarmed (lacking prickles), dark purple and hairy toward the apex, and brown and hairless below. The leaves are broadly elliptic, egg-shaped, or broadly oblong, and 16 to 40 centimeters (6 to 16 inches) long and 9.5 to 19.5 centimeters (3.7 to 7.7 inches) wide. The upper leaf surface is green, glossy, and hairless. The lower leaf surface is whitish green and glossy with scattered short white hairs on the midrib and veins. The leaf margins are hardened and slightly toothed. The inflorescence rises upward, contains 6 to 13 flowers, and is covered with short white hairs. The dark maroon sepal lobes are triangular or narrowly triangular, spreading or ascending, and 4 to 6 millimeters (0.2 inch) long and 1 to 2 millimeters (0.04 to 0.08 inch) wide. The tubular flowers, 40 to 53 millimeters (2 inches) long, have two lips, are dark purple (shading to purplish white at the apex of the lobes on their inner surface), and are densely covered with short white hairs. The flower tube is curved, 30 to 31 millimeters (1 inch) long and 5 to 5.5 millimeters (0.2 inch) in diameter. The staminal column is slightly protruding. The maroon or dark purple fruit is a round berry 10 to 13 millimeters (0.4 to 0.5 inch) in diameter, with orange flesh and small projections on the outer surface. *Cyanea remyi* is distinguished from others in the genus that grow on Kauai by its shrubby habit; relatively slender, unarmed (lacking prickles) stems; smooth or minutely toothed leaves; densely hairy flowers; the shape of the calyx lobes; length of the calyx and corolla; and length of the corolla lobe relative to the floral tube (USFWS 1996).

Life History

No life history information for this species is currently available.

Habitat Description

Cyanea remyi is usually found in lowland wet forest or shrubland at an elevation of 360 to 930 meters (1,180 to 3,060 feet). Associated plant species include hame, kanawao, ohia, *Freycinetia arborea* (ieie), and *Perrottetia sandwicensis* (olomea) (USFWS 1996).

Historic and Current Ranges and Population Status (Appendix K-5)

Cyanea remyi was originally known only from Remy's nineteenth century collection. In 1987, *Cyanea remyi* was collected in Blue Hole on Kauai but identified as *C. sylvestris*. The following year it was collected in the Wahiawa Mountains (Lammers & Lorence 1993). In 1991, *Cyanea remyi* was again collected in the Blue Hole, by botanists from the National Tropical Botanical Garden. Currently, this species exists at 5 widely seperated locations in northeastern and southeastern Kauai: a population of 14 plants in Waioli Valley; several hundred plants at the base of Mount Waialeale; about 140 to 180 plants in the Wahiawa Mountains, near Hulua; a population of about 10 to 50 plants on the summit plateau of the Makaleha Mountains and a population in Limahuli Valley with an unknown number of plants. This species, therefore, totals approximately 500 plants on State and private land (USFWS 1996; K. Wood and S. Perlman, personal communication 1997).

Reasons for Decline and Current Threats

Competition with the alien plant species fireweed, Hilo grass, *Psidium cattleianum* (strawberry guava), thimbleberry, and *Melastoma candidum*; habitat degradation by feral pigs; browsing by goats; predation by rats; unidentified slugs that feed on the stems; and a risk of extinction from naturally occurring events, due to the small number of remaining populations, are the major threats to *Cyanea remyi* (USFWS 1996).

Conservation Measures

Over 1,000 seeds of this species are in storage at the National Tropical Botanical Garden (G. Ray, personal communication 1997). No additional species-specific conservation efforts have been undertaken. General conservation efforts for the Kauai II Plant Cluster taxa can be found in the Overall Conservation Efforts section of this plan.

Needed Recovery Actions

1) Reduce threats from rodent and slug predation.

A management plan to control rats should be developed. This should include the use of the currently approved Diphacinone bait blocks and ultimately a more broad-scale method such as aerial dispersal of rodenticide. Methods to control slug predation on this species need to be determined and carried out.

2) Construct enclosures to protect against feral ungulates.

Enclosures on both State and private land should be constructed to reduce impacts from feral ungulates. Because some of the land is privately owned a commitment should be developed for long-term stewardship and conservation of these areas once they have been enclosed.

Additional recovery actions, as discussed in the Stepdown Narrative of the Recovery Plan for the Kauai Plant Cluster, beginning on page 138 of the Plan, are also appropriate for this species.

Cyrtandra cyaneoides Recovery Priority 2

(on USFWS scale of 1-18 (USFWS 1983) - See Appendix G of the Recovery Plan for the Kauai Plant Cluster.

Description and Taxonomy

No line drawing is available for *Cyrtandra cyaneoides*.

In 1909, J.F. Rock collected a plant specimen on Kauai that he named *Cyrtandra cyaneoides*. The specific epithet refers to the resemblance of this distinctive plant to a species of the endemic Hawaiian genus *Cyanea* (USFWS 1996).

Cyrtandra cyaneoides, a member of the African violet family (Gesneriaceae), is an erect or ascending, fleshy, usually unbranched shrub, about 1 to 4 meters (3.3 to 13.1 feet) tall (D. Lorence, personal communication 1997). The opposite, symmetrical, egg-shaped leaves are fleshy and leathery, 40 to 55 centimeters (16 to 22 inches) long and 22 to 35 centimeters (9 to 14 inches) wide. The upper surface of the toothed leaves is wrinkled with impressed veins and sparsely covered with long hairs. The lower surface has raised veins and is sparsely covered with hairs. The leaf stalks are 4.5 to 14 centimeters (1.8 to 5.5 inches) long and winged. The white flowers, covered with shaggy brown hairs, arise from the leaf axils in small dense clusters. The corolla tube (fused petals) is narrowly funnelform, curved near the middle, about 25 millimeters (1 inch) long, and hairless. The corolla lobes are elliptic and about 7 millimeters (0.3 inch) long. The bilaterally symmetrical calyx is spindle-shaped in bud and about 26 to 36 millimeters (1 to 1.4 inches) in length when the flower is fully open, but falls off after the flower matures. The fruit is an egg-shaped berry, which is covered with shaggy hairs, at least when young. Although poorly known, *Cyrtandra cyaneoides* is a very distinctive species. It differs from others of the genus that grow on Kauai by being a succulent, erect or ascending shrub and having a bilaterally symmetrical calyx that is spindle-shaped in bud and falls off after flowering; leaves with a wrinkled surface, 40 to 55 centimeters (16 to 22 inches) long and 22 to 35 centimeters (9 to 14 inches) wide; and berries with shaggy hairs (USFWS 1996).

Life History

No life history information for this species is currently available.

Habitat Description

This species typically grows on steep slopes or cliffs near streams or waterfalls in lowland or montane wet forest or shrubland dominated by ohia or a mixture of ohia and uluhe. Associated species include *Boehmeria grandis* (akolea), *Pipturus* sp. (mamaki), olapa, uki, *Athyrium* sp., and *Hedyotis* sp. (manono) (USFWS 1996).

Historic and Current Ranges and Population Status (Appendix K-6)

Cyrtandra cyaneoides was originally known only from the type collection made at Kaholuamanu 80 years ago, along the trail to Waialae Valley on the island of Kauai (USFWS 1996). In 1991, botanists from the National Tropical Botanical Garden discovered a population of 50 to 100 individuals at Namolokama above Lumahai Valley. Four additional populations were discovered over the next 2 years: 1 plant on the Makaleha Plateau; more than 300 plants in Wainiha Valley; 1 plant in upper Waioli Valley (USFWS 1996); and an unknown number of plants in Koaie Canyon (K. Wood and S. Perlman, personal communication 1997) for a total of between 350 and 400 plants. The five populations occur on private and State land, between 550 and 1,220 meters (1,800 and 4,000 feet) elevation.

Reasons for Decline and Current Threats

The major threats to *Cyrtandra cyaneoides* is competition with alien plant species such as Hilo grass, thimbleberry, *Deparia petersenii*, and *Drymaria cordata* (pipili) and predation of seeds by rats. Because of the small number of populations, this species is especially vulnerable to extinction by reduced reproductive vigor and from naturally occurring events (for example, landslides and hurricanes). Feral pigs are reported to occur in lower Wainiha Valley; however, no evidence exists of their incursion into the upper valley to date (USFWS 1996).

Conservation Measures

Over 1,000 seeds of this species are in storage at the National Tropical Botanical Garden (G. Ray, personal communication 1997). No additional species-specific conservation efforts have been undertaken. General conservation efforts for the Kauai II Plant Cluster taxa can be found in the Overall Conservation Efforts section of this plan.

Needed Recovery Actions

1) Maintenance of adequate genetic stock.

In order to prevent this taxon from going extinct, propagation efforts and the maintenance of adequate genetic stock *ex situ* should be continued. Additional wild seeds should be collected periodically until the cryopreservation method of long-term storage is perfected. This will insure that viable seed stock is available for outplanting. Additionally, specific efforts should be made to immediately collect from those populations that have only one remaining individual, such as the Makaleha Plateau and Waioli Valley populations.

2) Development of management plans to control alien plant species.

A long-range management plan to control alien plant species, such as fireweed, Hilo grass, thimbleberry, *Deparia petersenii*, and pipili needs to be developed. Additionally, specific efforts should be made to immediately weed and protect those populations that have only one remaining individual, such as the Makaleha Plateau and Waioli Valley populations. Because some of the land is privately owned, a commitment should be developed for long-term stewardship and conservation of these areas. Once an active management plan for control of alien plants in these areas is in place, site selection and outplanting should occur to prevent wild stocks from declining further.

3) Reduce threat from rodent predation.

A management plan to control rats should be developed. This should include the use of the currently approved Diphacinone bait blocks and ultimately a more broad-scale method such as aerial dispersal of rodenticide.

Additional recovery actions, as discussed in the Stepdown Narrative of the Recovery Plan for the Kauai Plant Cluster, beginning on page 138 of the Plan, are also appropriate for this species.

Delissea rivularis **Recovery Priority 5**

(on USFWS scale of 1-18 (USFWS 1983) - See Appendix G of the Recovery Plan for the Kauai Plant Cluster.

Description and Taxonomy

No line drawing is available for *Delissea rivularis*.

In 1909, J.F. Rock collected a plant specimen on Kauai that he later named *Cyanea rivularis*. In 1943, F.E. Wimmer transferred this species to *Delissea*, and Thomas Lammers, in the current treatment of this endemic Hawaiian genus, concurred. The specific epithet refers to streams or brooks, the typical habitat of this plant (USFWS 1996).

Delissea rivularis, a member of the bellflower family, is a shrub, unbranched or branched near the base, with hairy stems 4 to 5 meters (13 to 16 feet) long. The leaves are arranged in a rosette at the tips of the stems. The elliptic to lance-shaped leaves are 20 to 30 centimeters (8 to 12 inches) long and 3 to 8 centimeters (1.2 to 3.2 inches) wide, with minutely toothed margins. Both leaf surfaces are covered with hairs. Six to 12 flowers are arranged on an inflorescence stalk 4 to 8 centimeters (1.6 to 3.2 inches) long, each having an individual stalk 10 to 15 millimeters (0.4 to 0.6 inch) in length. The curved, hairy flowers are white with blue longitudinal stripes, 30 to 40 millimeters (1.2 to 1.6 inch) long, with one dorsal knob. The fruit is a spherical, dark purple berry 10 to 15 millimeters (0.4 to 0.6 inch) in diameter. This species is distinguished from others of the genus by the color, length, and curvature of the corolla; shape of the leaves; and presence of hairs on the stems, leaves, flower clusters, and corolla (USFWS 1996).

Life History

No life history information for this species is currently available.

Habitat Description

Delissea rivularis is found on steep slopes in ohia-olapa montane wet or mesic forest, near streams. Associated native species include kanawao, *Athyrium* sp., *Carex* sp., *Coprosma* sp. (pilo), and *Sadleria* sp. (amau) (USFWS 1996).

Historic and Current Ranges and Population Status Appendix K-7)

Historically, *Delissea rivularis* was found at Waiakealoha waterfall (location unknown), Waialae Valley, Hanakoa Valley, and Kaholuamano on the island of Kauai. This species was recently recollected after almost 80 years from the upper Hanakoa Valley stream area of northwestern Kauai. This population of 15 to 20 plants, scattered over an area of more than 100 square meters (1,100 square feet), is on State land within the Hono O Na Pali Natural Area Reserve at about 1,190 meters (3,900 feet) elevation (USFWS 1996). An additional population of 20 plants was discovered in the upper Hanakapiai drainage (K. Wood and S. Perlman, personal communication 1997). A small population existed in the Blue Hole area below Waialeale, but plants have not been found there since Hurricane Iniki, and this population may have been extirpated (USFWS 1996).

Reasons for Decline and Current Threats

The major threats to *Delissea rivularis* are competition with the encroaching alien plant prickly Florida blackberry, habitat destruction by feral pigs, predation by rats, and reduced reproductive vigor and a risk of extinction from naturally occurring events due to the small number of remaining individuals (USFWS 1996).

Conservation Measures

Seeds of this species are being stored at the National Tropical Botanical Garden and it has been propagated by tissue culture at Lyon Arboretum (G. Ray, personal communication 1997). No additional species-specific conservation efforts have been undertaken. General conservation efforts for the Kauai II Plant Cluster taxa can be found in the Overall Conservation Efforts section of this plan.

Needed Recovery Actions

1) Maintenance of adequate genetic stock.

In order to prevent this taxon from going extinct, propagation efforts and the maintenance of adequate genetic stock *ex situ* should be continued. Additional wild seeds should be collected periodically until the cryopreservation method of long-term storage is perfected. This will insure that viable seed stock is available for outplanting.

2) Development of management plans to control alien plant species.

A long-range management plan to control alien plant species in the upper Hanakoa Valley, upper Hanakapiai drainage and on State land within the Hono O Na Pali Natural Area Reserve needs to be developed. Once an active management plan for control of alien plants in these areas is in place, site selection and outplanting should occur to prevent wild stocks from declining further.

3) Reduce threat from rodent predation.

A management plan to control rats should be developed. This should include the use of the currently approved Diphacinone bait blocks and ultimately a more broad-scale method such as aerial dispersal of rodenticide.

Additional recovery actions, as discussed in the Stepdown Narrative of the Recovery Plan for the Kauai Plant Cluster, beginning on page 138 of the Plan, are also appropriate for this species.

Hibiscadelphus woodii Recovery Priority 5
(on USFWS scale of 1-18 (USFWS 1983) - See Appendix G of the Recovery Plan for the Kauai Plant Cluster.

Description and Taxonomy

Appendix J contains a line drawing of this taxon.

In 1991, several new species were collected by Ken Wood of the National Tropical Botanical Garden, M. Query, and Steve Montgomery on the cliff walls of Kalalau Valley, Kauai, including a new species in the endemic Hawaiian genus *Hibiscadelphus*. *Hibiscadelphus woodii* was described in 1995 by David Lorence and Warren Wagner (USFWS 1996).

Hibiscadelphus woodii, a member of the mallow family (Malvaceae), is a small branched tree 2.5 to 5 meters (8.2 to 16.4 feet) tall with a rounded crown. The leaves have stalks 2.8 to 5.8 centimeters (1.1 to 2.3 inches) long, with star-shaped hairs when young, which are mostly lost as the leaf matures. Awl-shaped stipules, also covered with star-shaped hairs, are found at the base of the leaf stalk. The leaf blade is ovate, 7 to 9 centimeters (2.6 to 3.5 inches) long, and 6.5 to 8.4 centimeters (2.6 to 3.3 inches) wide. Star-shaped hairs are scattered along the veins of the leaves. The leaf margins are irregularly and coarsely toothed with the teeth either pointed or rounded. Flowers are borne individually on stalks 1.4 to 2.1 centimeters (0.6 to 0.8 inch) long with star-shaped hairs. Below each flower are four to six bracts 11 to 15 millimeters (0.4 to 0.6 inch) long and 1.8 to 4 millimeters (0.07 to 0.16 inch) wide. The calyx is tubular, 1.3 to 1.5 centimeters (0.5 to 0.6 inch) long, green, shallowly lobed, and moderately hairy with star-shaped hairs. The corolla is 4.5 to 4.7 centimeters (1.8 to 1.9 inches) long, yellow with a coppery tinge when fresh, which rapidly turns purplish-maroon. The staminal column extends about 7 millimeters (0.3 inch) beyond the lobes of the corolla. Fruits are not known from this species. *Hibiscadelphus woodii* differs from the other Kauai species by differences in leaf surface and involucral bract characters, and by flower color (USFWS 1996).

Life History

Flowering material has been collected in March, April, and September. But no fruit set has been observed in spite of efforts to manually outcross and bag the flowers. A liquid-preserved flower contained three adult Nitidulidae beetles probably representing an endemic species. The damage by these larvae may be responsible for the observed lack of fruit set in *Hibiscadelphus woodii* (D. H.

Lorence & W. L. Wagner, 1995). No additional life history information for this species is currently available.

Habitat Description

The plants grow on cliff walls in an ohia montane mesic forest with alani, *Dubautia* sp. (naenae), *Lepidium serra* (anaunau), *Lipochaeta* sp. (nehe), *Lysimachia* sp., *Chamaesyce* sp. (akoko), mamane, *Nototrichium* sp. (kului), *Myrsine* sp. (kolea), and the federally endangered species *Stenogyne campanulata*, *Lobelia niihauensis*, and *Poa mannii* (Mann's bluegrass) (USFWS 1996).

Historic and Current Ranges and Population Status (Appendix K-8)

Hibiscadelphus woodii has been found only at the site of its discovery in Kalalau Valley on the island of Kauai within the Na Pali Coast State Park, from about 990 to 1,000 meters (3,250 to 3,280 feet) elevation. Only four trees of this species are known.

Reasons for Decline and Current Threats

Habitat degradation by feral goats and pigs, competition and invasion by the alien plant species *Erigeron karvinskianus* (daisy fleabane), nectar robbing by Japanese white-eye (*Zosterops japonicus*), and a risk of extinction from naturally occurring events (e.g., rock slides) and from reduced reproductive vigor, due to the small number of existing individuals in the only known population, are the major threats to *Hibiscadelphus woodii* (USFWS 1996).

Conservation Measures

Recent attempts to propagate this new species by tissue culture at the Lyon Arboretum have been successful (G. Ray, personal communication 1997).

Needed Recovery Actions

1) Conduct and encourage research on limiting factors.

The degree of damage resulting from nectar robbing by the Japanese white-eye, with emphasis on management strategies to reduce the impacts of these birds, should be assessed.

2) Aerial hunting to reduce feral ungulates and subsequent control of alien plant species.

Due to the steep terrain, fencing could potentially cause erosion or landslides that would negatively impact the plants. Aerial hunting would reduce the number of ungulates without increasing erosion. Once the numbers of feral ungulates are reduced, alien plant control should be initiated.

3) Outplant additional plants in areas of reduced threat.

Attempts should be made to establish this species in an outplanting site free from impacts of feral goats and pigs, and natural events such as rock slides.

Additional recovery actions, as discussed in the Stepdown Narrative of the Recovery Plan for the Kauai Plant Cluster, beginning on page 138 of the Plan, are also appropriate for this species.

Hibiscus waimeae* ssp. *hannerae Recovery Priority 3
(on USFWS scale of 1-18 (USFWS 1983) - See Appendix G of the Recovery Plan for the Kauai Plant Cluster.

Description and Taxonomy

No line drawing is available for *Hibiscus waimeae* ssp. *hannerae*.

Reverend John Mortimer Lydgate collected *Hibiscus waimeae* ssp. *hannerae* on Kauai in 1913, and more than 60 years passed before it was collected again, in 1978, by Steve Perlman. Otto and Isa Degener named Lydgate's collection as a variety of *Hibiscus waimeae* in honor of Mrs. Ruth Knudsen Hanner, a supporter of their work on Kauai. David M. Bates, the author of the current treatment of the Hawaiian members of the family, elevated the varietal name to a subspecies (USFWS 1996).

Hibiscus waimeae ssp. *hannerae*, a member of the mallow family, is a gray-barked tree, 6 to 10 meters (20 to 33 feet) tall, with star-shaped hairs densely covering its leaf and flower stalks and branchlets. The circular to broadly egg-shaped leaves are usually 5 to 18 centimeters (2 to 7 inches) long and 3 to 13 centimeters (1.2 to 5 inches) wide. The strongly fragrant flowers are borne singly near the ends of the branches on flower stalks 2 to 3 centimeters (0.8 to 1.2

inches) long. The calyx is tubular, normally 3 to 4.5 centimeters (1.2 to 1.8 inches) long, with lobes 8 to 15 millimeters (0.2 to 0.6 inch) long. The flaring petals are white when the flower opens in the morning, but fade to pinkish in the afternoon. The petals, usually 4 to 6 centimeters (1.6 to 2.4 inches) long, are basally attached to the staminal column to form a tube about 1.5 centimeters (0.6 inch) long. The exserted staminal column is up to 15 centimeters (6 inches) long and reddish to crimson at the tip. The filaments arise in the upper half of the staminal column and spread up to 2.5 centimeters (1 inch) long. The fruit is a cartilaginous, egg-shaped capsule 1.8 to 2.5 centimeters (0.7 to 1 inch) long and hairless. Two subspecies are recognized, both occurring on Kauai: ssp. *hannerae* and ssp. *waimeae*. Subspecies *hannerae* is distinguished by having larger leaves but smaller flowers. The species is distinguished from others of the genus by the position of the anthers along the staminal column, length of the staminal column relative to the petals, color of the petals, and length of the calyx (USFWS 1996).

Life History

No life history information for this species is currently available

Habitat Description

In Limahuli Valley, *Hibiscus waimeae* ssp. *hannerae* is growing in an ohia-uluhe lowland wet forest between 190 and 560 meters (620 and 1,850 feet) elevation. At this location, associated species include ahakea, amau, haha, haiwale, and *Syzygium* sp. The Hanakapiai Valley population is growing in *Pisonia* sp. (papala kepau) - *Charpentiera elliptica* (papala) lowland mesic forest with ahakea, hame, kopiko, mamaki, and the alien species *Aleurites moluccana* (kukui), between 220 and 370 meters (720 and 1,200 feet) (USFWS 1996).

Historic and Current Ranges and Population Status (Appendix K-9)

Three collections of *Hibiscus waimeae* ssp. *hannerae* are known, all from the island of Kauai. The Kalihiwai population of this subspecies is apparently extinct and the 2 remaining populations are found in adjacent valleys on Kauai's northern coast on State and private land, and total between 75 and 125 individuals. Between 50 and 100 plants are scattered over a 100-square-meter (1,100-square-foot) area along the stream in Limahuli Valley, and another 50 or so plants were distributed over a 10- to 100-square-meter (110- to 1,100-square-foot) area below the cliffs in the back of Hanakapiai Valley before Hurricane Iniki. After the hurricane, only 25 plants remained in Hanakapiai Valley (USFWS 1996).

Reasons for Decline and Current Threats

The major threats to *Hibiscus waimeae* ssp. *hannerae* are habitat degradation by feral pigs; competition with alien plant species, including thimbleberry, Koster's curse, *Aleurites moluccana* (kukui), and lantana; and a risk of extinction from naturally occurring events (e.g., hurricanes) and from reduced reproductive vigor due to the small number of remaining populations (USFWS 1996).

Conservation Measures

Since Hurricane Iniki in 1992, the National Tropical Botanical Garden has propagated 13 plants from cuttings collected from upper Limahuli Preserve in June and July, 1997. These plants will be outplanted in Limahuli Preserve in the near future (K. Wood and S. Perlman, personal communication 1997).

A total of 27 plants of this species have been successfully cultivated on the grounds of the National Tropical Botanical Garden and Waimea Arboretum (G. Ray, personal communication 1997). No additional species-specific conservation efforts have been undertaken. General conservation efforts for the Kauai II Plant Cluster taxa can be found in the Overall Conservation Efforts section of this plan.

Needed Recovery Actions

1) Construct enclosures around two remaining populations along the stream in Limahuli Valley and the back of Hanakapiai Valley.

Without this protection, this species will continue to decline due to degradation of habitat by feral pigs. Once enclosed, those areas should undergo management to remove alien plant species like thimbleberry, Koster's curse, and lantana.

2) Begin attempts to outplant in protected areas in order to increase reproductive vigor.

Because of the success in cultivating additional plants on the grounds of the National Tropical Botanical Garden and Waimea Arboretum, attempts to outplant should occur in areas that have been protected and are under management to control alien plant species such as at Limahuli Preserve. This will also reduce the risk of extinction from naturally occurring events.

Additional recovery actions, as discussed in the Stepdown Narrative of the Recovery Plan for the Kauai Plant Cluster, beginning on page 138 of the Plan, are also appropriate for this species.

Kokia kauaiensis Recovery Priority 5

(on USFWS scale of 1-18 (USFWS 1983) - See Appendix G of the Recovery Plan for the Kauai Plant Cluster.

Description and Taxonomy

Appendix J contains a line drawing of this taxon.

In 1919, J.F. Rock and Augustus F. Knudsen collected a specimen of a tree that Rock named as *Kokia rockii* var. *kauaiensis*. Later, Otto Degener and Albert W. Duvel elevated the variety to a full species, *Kokia kauaiensis*. The current treatment of the family upholds this designation (USFWS 1996).

Kokia kauaiensis, a member of the mallow family, is a tree 5 to 10 meters (16.4 to 33 feet) tall. The seven- or nine-lobed, circular leaves are 12 to 25 centimeters (5 to 10 inches) wide with a heart-shaped base. The solitary, brick-red flowers are clustered near the ends of the branches on stout flower stalks 3 to 9 centimeters (1.2 to 3.5 inches) long. The broadly egg-shaped floral bracts are 4 to 6 centimeters (1.5 to 2.4 inches) long and hairless except toward the base, which has a sparse covering of long, soft hairs. The curved petals, 10 to 15 centimeters (4 to 6 inches) long, are twisted at the base and densely covered with yellowish, silky hairs. The fruit is an egg-shaped capsule. The egg-shaped seeds are 10 to 12 millimeters (0.4 to 0.5 inch) long and densely covered with reddish, woolly hairs up to 10 millimeters (0.4 inch) long. This species is distinguished from others of this endemic Hawaiian genus by the length of the bracts surrounding the flower head, number of lobes and the width of the leaves, the length of the petals, and the length of the hairs on the seeds (USFWS 1996).

Life History

No life history information for this species is currently available

Habitat Description

This species typically grows in diverse mesic forest at elevations between 475 and 795 meters (1,960 and 2,600 feet). Associated species include ahakea, koa, kukui, *Diospyros sandwicensis* (lama), maaono, hala pepe, papala, *Nestegis sandwicensis* (olopua), and ohia (USFWS 1996).

Historic and Current Ranges and Population Status (Appendix K-10)

Historically, *Kokia kauaiensis* was found at seven scattered populations on northwestern Kauai. This species is currently found at six populations on State land in the following areas: Paaiki Valley; Mahanaloa Valley; Kuia Valley; the western side of Kalalau Valley, and Pohakuao Valley, both within Na Pali Coast State Park; and Koaie Stream branch of Waimea Canyon, where some plants may be within the boundary of the Alakai Wilderness Preserve. The 3 largest populations contain between 30 and 50 individuals each, with the others each numbering fewer than 10 individuals. Estimates of the total number of individuals range from 105 to 150 (USFWS 1996, K. Wood and S. Perlman, personal communication 1997).

Reasons for Decline and Current Threats

Competition with and habitat degradation by the invasive alien plant species lantana, *Passiflora ligularis* (sweet granadilla), thimbleberry, *Kalanchoe pinnata* (air plant), strawberry guava, and *Triumfetta semitriloba* (Sacramento bur); substrate loss, from erosion; habitat degradation and browsing by feral goats and black-tail deer (*Odocoileus hemionus*); and predation by rats, which eat the seeds, are the major threats affecting the survival of *Kokia kauaiensis* (USFWS 1996).

Conservation Measures

The population of *Kokia kauaiensis* in Paaiki Valley has been fenced by the Kauai Division of Forestry and Wildlife (Alvin Kyono, Kauai Division Of Forestry And Wildlife, personal communication 1997). This species has been propagated by seed and tissue culture and over 50 plants have been cultivated in botanical gardens (G. Ray, personal communication 1997). General conservation efforts for the Kauai II Plant Cluster taxa can be found in the Overall Conservation Efforts section of this plan.

Needed Recovery Actions

1) Remove alien plants inside completed enclosures.

The Paaiki Valley population is now protected from imminent destruction by goats. However, broad-scale control of rats and alien weeds should begin inside the area that has been enclosed.

Additional recovery actions, as discussed in the Stepdown Narrative of the Recovery Plan for the Kauai Plant Cluster, beginning on page 138 of the Plan, are also appropriate for this species.

***Labordia tinifolia* var. *wahiawaensis* Recovery Priority 6**
(on USFWS scale of 1-18 (USFWS 1983) - See Appendix G of the Recovery Plan for the Kauai Plant Cluster.

Description and Taxonomy

No line drawing is available for *Labordia tinifolia* var. *wahiawaensis*.

Based upon a specimen collected by Steve Perlman on Kauai in 1980, Harold St. John described *Labordia tinifolia* var. *wahiawaensis*, naming it for the Wahiawa Mountains where it was first collected (USFWS 1996).

Labordia tinifolia var. wahiawaensis, a member of the logania family (Loganiaceae), is a shrub or small tree, usually 2 to 8 meters (6.6 to 26.2 feet) tall. The young branches are cylindrical or nearly so and hairless. The elliptic to lance-shaped leaves are usually 4.5 to 21 centimeters (1.8 to 8.3 inches) long and 2 to 5 centimeters (0.8 to 2 inches) wide. The membranous leaves are medium green and hairless, and the veins are not impressed on the upper leaf surface. Normally, 9 to 12 hairless flowers are clustered on a downward curving inflorescence stalk 9 to 22 millimeters (0.35 to 0.9 inch) long, each having an individual stalk 8 to 11 millimeters (0.2 to 0.4 inch) in length. The pale yellowish green flower is narrowly urn-shaped, 17 to 19 millimeters (0.7 to 0.75 inch) long. The tubular portion of the flower is 5.5 to 7.8 millimeters (0.2 to 0.3 inch) long with long, white hairs inside, while the egg-shaped lobes are 1.7 to 2.3 millimeters (0.07 to 0.09 inch) long. The fruit is an egg-shaped capsule, 8 to 17 millimeters (0.2 to 0.7 inch) long, usually with two valves and an apex with a beak 0.5 to 1.5

millimeters (0.02 to 0.1 inch) long. Three varieties of *Labordia tinifolia* are recognized: var. *lanaiensis* on Lanai and Molokai, var. *tinifolia* on Kauai and four other islands, and var. *wahiawaensis*, endemic to Kauai. Variety *wahiawaensis* is distinguished from the other two by its larger corolla. This species differs from others of the genus by having a long common flower cluster stalk, hairless young stems and leaf surfaces, transversely wrinkled capsule valves, and corolla lobes usually 1.7 to 2.3 millimeters (0.1 inch) long (USFWS 1996).

Life History

No life history information for this species is currently available.

Habitat Description

Labordia tinifolia var. *wahiawaensis* grows along streams in lowland wet forests dominated by ohia and often in association with olapa or uluhe. Plants found in association with this taxon include haiwale, hame, kopiko, manono, and *Athyrium* sp. (USFWS 1996).

Historic and Current Ranges and Population Status (Appendix K-11)

Labordia tinifolia var. *wahiawaensis* is only known from the Wahiawa Drainage in the Wahiawa Mountains of Kauai from about 630 to 740 meters (2,070 to 2,430 feet) elevation on privately owned land, within a 0.8- by 1.2-kilometer (0.5- by 0.75-mile) area. More than 100 plants grew in the area before Hurricane Iniki swept over Kauai in 1992. During a 1994 visit to the area, only 20 to 30 surviving individuals were found (USFWS 1996).

Reasons for Decline and Current Threats

The primary threats to the remaining individuals of *Labordia tinifolia* var. *wahiawaensis* are competition with the alien plant strawberry guava, habitat degradation by pigs, trampling by humans, and a risk of extinction from naturally occurring events and from reduced reproductive vigor due to the small number of individuals in the only known population (USFWS 1996).

Conservation Measures

This species has been successfully propagated from seeds and plants are in cultivation at Waimea Arboretum (G. Ray, personal communication 1997). No additional species-specific conservation efforts have been undertaken. General conservation efforts for the Kauai II Plant Cluster taxa can be found in the Overall Conservation Efforts section of this plan.

Needed Recovery Actions

1) Construct enclosures to protect against feral ungulates and control alien plant species.

Because so few individuals now exist, emergency measures should be taken immediately to fence the remaining individuals to protect them against further degradation by feral pigs. Once enclosed, those areas should undergo management to remove the alien plants focusing on strawberry guava.

2) Begin attempts to outplant in protected areas in order to increase reproductive vigor.

Because of the success in propagating additional plants from seeds on the grounds of the National Tropical Botanical Garden and Waimea Arboretum, attempts should be made to collect and broadcast seeds in areas that have been protected and are under management to control alien plant species. This will reduce the risk of extinction from naturally occurring events.

Additional recovery actions, as discussed in the Stepdown Narrative of the Recovery Plan for the Kauai Plant Cluster, beginning on page 138 of the Plan, are also appropriate for this species.

Myrsine linearifolia Recovery Priority 2

(on USFWS scale of 1-18 (USFWS 1983) - See Appendix G of the Recovery Plan for the Kauai Plant Cluster.

Description and Taxonomy

Appendix J contains a line drawing of this taxon.

Lydgate first collected *Myrsine linearifolia* on Kauai in 1912. Edward Y. Hosaka chose the specific epithet to describe its distinctive linear-lanceolate curved leaves. In an action that was not supported by other taxonomists, Otto and Isa Degener transferred several species from the genus *Myrsine* to the genus

Rapanea based upon minute floral features. The currently accepted treatment of the Hawaiian members of the family follows Hosaka's earlier, broad concept of *Myrsine* (USFWS 1996).

Myrsine linearifolia, a member of the myrsine family (Myrsinaceae), is a branched shrub, 2.5 to 8 meters (8.2 to 26.2 feet) tall. The slightly fleshy, linear leaves are 5 to 9 centimeters (1.7 to 3 inches) long, 0.25 to 0.4 centimeter (0.09 to 0.14 inch) wide, often yellowish purple toward the base, and tend to be clustered toward the upper branches. The margins of the leaves are smooth and roll slightly toward the underside of the leaf. One to three apparently perfect (containing male and female parts) flowers, on stalks 1 to 4.2 millimeters (0.04 to 0.17 inch) long, occur in clusters among the leaves. The greenish petals are inversely lance-shaped, about 2.2 to 2.5 millimeters (0.09 to 0.1 inch) long, and also have margins fringed with hairs. At maturity, the fruits are black elliptic-shaped drupes, about 6 millimeters (0.2 inch) long. This species is distinguished from others of the genus by the shape, length, and width of the leaves, length of the petals, and number of flowers per cluster (USFWS 1996).

Life History

No life history information for this species is currently available.

Habitat Description

Myrsine linearifolia typically grows in mesic to wet ohia forests that are sometimes co-dominant with olapa or uluhe from 585 to 1,280 meters (1,920 to 4,200 feet) elevation (USFWS 1996). Plants growing in association with this species include ahakea, aiea, alani, *Eurya sandwicensis* (anini), kopiko, *Lysimachia* sp., and native ferns.

Historic and Current Ranges and Population Status (Appendix K-12)

Historically, *Myrsine linearifolia* was found at nine scattered locations on Kauai: Olokele Valley, Kahualea, Kalalau Valley, Kahuamaa Flat, Limahuli-Hanakapiai Ridge, Koaie Stream, Pohakuao, Namolokama Summit Plateau, and Haupu. This species is currently found at seven of those nine populations on State and private land: Kalalau Valley, Kahuamaa Flat, Limahuli Valley, Hanakapiai Ridge, Koaie Stream, Pohakuao, and Namolokama Summit Plateau. Additionally, a new population was discovered in Wahiawa Drainage. The largest population, located in Kalalau Valley, contains several hundreds of individuals. The remaining 7 populations total about 100 plants; hence, approximately 1,000 to 1,500 individuals are known for the entire species (USFWS 1996).

Reasons for Decline and Current Threats

Competition with alien plants such as daisy fleabane, lantana, prickly Florida blackberry, strawberry guava, thimbleberry, and air plant, and habitat degradation by ungulates such as pigs and goats are major threats to *Myrsine linearifolia* (USFWS 1996).

Conservation Measures

This species has been successfully propagated from seeds and tissue culture, and two plants were in cultivation on the grounds of the National Tropical Botanical Garden; however, these plants have since died (Melany Chapin, National Tropical Botanical Garden, personal communication 1997). No other species-specific conservation efforts have been undertaken. General conservation efforts for the Kauai II Plant Cluster taxa can be found in the Overall Conservation Efforts section of this plan.

Needed Recovery Actions

1) Maintenance of adequate genetic stock.

Maintenance of adequate genetic stock *ex situ* should be continued. Additional wild seeds should be collected periodically until the cryopreservation method of long-term storage is perfected. This will insure that viable seed stock is available for outplanting.

2) Development of management plans to control alien plant species.

A long-range management plan to control alien plant species in the eight populations, with special emphasis on the largest population located in Kalalau Valley, which contains several hundred individuals, needs to be developed. Because some of the land is privately owned, a commitment should be developed for long-term stewardship and conservation of these areas. Active management should include control of the following alien plants: daisy fleabane, lantana, prickly Florida blackberry, strawberry guava, thimbleberry, and air plant.

Additional recovery actions, as discussed in the Stepdown Narrative of the Recovery Plan for the Kauai Plant Cluster, beginning on page 138 of the Plan, are also appropriate for this species.

Phyllostegia knudsenii Recovery Priority 5

(on USFWS scale of 1-18 (USFWS 1983) - See Appendix G of the Recovery Plan for the Kauai Plant Cluster.

Description and Taxonomy

No line drawing is available for *Phyllostegia knudsenii*.

Hillebrand described *Phyllostegia knudsenii* from a specimen collected by Knudsen in the 1800s. He chose the specific epithet to honor the collector (USFWS 1996).

Phyllostegia knudsenii, a member of the mint family (Lamiaceae), is an erect, perennial herb or vine. The opposite leaves are limp, ovate, faintly hairy, 11.5 to 18 centimeters (4.5 to 7 inches) long, and 5.1 to 9 centimeters (2 to 3.5 inches) wide. Flowers are borne in groups of two to four along a flower stalk 4 to 6.5 centimeters (1.6 to 2.6 inches) long. The corolla is 6 to 8 millimeters (0.2 to 0.3 inch) long. The fruits are four black, fleshy nutlets in each flower and are 1.5 to 2 millimeters (0.06 to 0.08 inch) long. This species differs from others in this genus in its specialized flower stalk. It differs from the closely related *Phyllostegia floribunda* in often having four flowers per group (USFWS 1996).

Life History

No life history information for this species is currently available.

Habitat Description

This species is found in ohia lowland mesic forest at 865 meters (2,840 feet) elevation. Associated species include olomea, *Cyrtandra kauaiensis* (ulunahele), *Cyrtandra paludosa* (moa), *Elaeocarpus bifidus* (kalia), *Cryptocarya mannii* (holio), *Doodia kunthiana*, *Selaginella arbuscula*, lama, *Zanthoxylum dipetalum* (ae), *Pittosporum* sp. (hoawa), *Pouteria sandwicensis* (alaa), and *Pritchardia minor* (loulu) (USFWS 1996).

Historic and Current Ranges and Population Status (Appendix K-13)

Until 1993, *Phyllostegia knudsenii* was only known from the type collection made in the 1800s from the woods of Waimea. In 1993, botanists at National Tropical Botanical Garden rediscovered one individual of this species in Koaie Canyon (USFWS 1996). Since then two more individuals of this species were found in the same area (Donna Damron, NTBG, *in litt.* 1997).

Reasons for Decline and Current Threats

Major threats to *Phyllostegia knudsenii* include habitat degradation by pigs and goats; competition with alien plant species such as pipili, Hilo grass, lantana, and air plant; and a risk of extinction from naturally occurring events (e.g., landslides) and reduced reproductive vigor due to the small number of individuals in the only known population (USFWS 1996).

Conservation Measures

A single seed is in storage at the National Tropical Botanical Garden (G. Ray, personal communication 1997). In 1997 fencing was constructed around the three known plants by the State of Hawaii's Department of Forestry and Wildlife (A. Kyono, Kauai DOFAW, personal communication 1997). Additional conservation efforts needed for the Kauai II Plant Cluster taxa can be found in the Overall Conservation Efforts section of this plan.

Needed Recovery Actions

1) Maintenance of adequate genetic stock.

In order to prevent this taxon from going extinct, propagation efforts and the maintenance of adequate genetic stock *ex situ* should be continued. Additional wild seeds should be collected periodically until the cryopreservation method of long-term storage is perfected. Additionally, specific monitoring efforts should be made so that any seeds produced can be collected immediately from the one individual discovered in Koaie Canyon.

2) Construct enclosure to protect against feral ungulates and control alien plant species.

Emergency measures should be taken immediately to fence the remaining individual to protect it against further degradation by feral pigs. Once enclosed, this area should undergo management to remove the alien plants, focusing on the following alien plants: pipili, Hilo grass, lantana, and air plant.

Additional recovery actions, as discussed in the Stepdown Narrative of the Recovery Plan for the Kauai Plant Cluster, beginning on page 138 of the Plan, are also appropriate for this species.

Phyllostegia wawrana Recovery Priority 5

(on USFWS scale of 1-18 (USFWS 1983) - See Appendix G of the Recovery Plan for the Kauai Plant Cluster.

Description and Taxonomy

No line drawing is available for *Phyllostegia wawrana*.

Phyllostegia wawrana was described by Sherff from a collection made in the 1800s. Sherff choose the specific epithet to honor the collector, Dr. Heinrich Wawra (USFWS 1996).

Phyllostegia wawrana, a member of the mint family, is a perennial vine that is woody toward the base and has long, crinkly hairs along the stem. The leaves are opposite, ovate, and covered with hairs, especially along the veins of the lower surface. The leaves are 10.5 to 20 centimeters (4.1 to 7.8 inches) long and 4 to 11 centimeters (1.6 to 4.3 inches) wide. Flowers are borne in groups of four to six along a leafy flower stalk with one or two short lateral branches. Each of these lateral branches have a pair of leaves at the base. The corolla tube is about 10 millimeters (0.03 inch) long, with an upper lip about 2 millimeters (0.08 inch) long. The fruits are four greenish-black nutlets in each flower and are about 2 millimeters (0.08 inch) long. This species may be related to *Phyllostegia floribunda* and *Phyllostegia knudsenii*, but has a less specialized flower stalk (USFWS 1996).

Life History

Seeds were observed by botanists from the National Tropical Botanical Garden in August of 1993 (S. Perlman, NTBG, Provenance Report 1993). No additional life history information for this species is currently available.

Habitat Description

This species grows in ohia-dominated forest with either olapa or uluhe as codominant species. Associated species include *Diplazium sandwichianum*, ohelo, kanawao, kolea, kopiko, *Dubautia knudsenii* (naenae), *Scaevola procera* (naupaka kuahiwi), *Gunnera sp.*, *Pleomele aurea* (hala pepe), *Claoxylon sandwicense* (poola), *Elaphoglossum sp.*, ala ala wai nui, manono, hapuu, amau, hoawa, uki, and *Syzygium sandwicensis* (ohia ha) (USFWS 1996).

Historic and Current Ranges and Population Status (Appendix K-14)

Phyllostegia wawrana was reported from Hanalei in the 1800s and was last observed along Kokee Stream in 1926, until 1993 when National Tropical Botanical Garden botanists found three populations on State-owned land. Currently there are a total of 20-30 individuals in the Makaleha Mountains, 5 or 6 plants in Honopu Valley (USFWS 1996), and 20 plants in Hanakoa Valley (K. Wood and S. Perlman, personal communication 1997).

Reasons for Decline and Current Threats

The major threats to *Phyllostegia wawrana* include degradation of habitat by feral pigs and competition with alien plant species such as thimbleberry, *Passiflora mollissima* (banana poka), prickly Florida blackberry, *Melastoma candidum*, fireweed, and daisy fleabane (USFWS 1996).

Conservation Measures

This species has been successfully propagated from seed, and one plant is in cultivation at the National Tropical Botanical Garden (G. Ray, personal communication 1997). No additional species-specific conservation efforts have been undertaken. General conservation efforts for the Kauai II Plant Cluster taxa can be found in the Overall Conservation Efforts section of this plan.

Needed Recovery Actions

1) Maintenance of adequate genetic stock.

In order to prevent this taxon from going extinct, propagation efforts and the maintenance of adequate genetic stock *ex situ* should be continued. Additional wild seeds should be collected periodically until the cryopreservation method of long-term storage is perfected. This will insure that viable seed stock is available for outplanting.

2) Construct enclosures to protect against feral ungulates and control alien plant species.

Because so few individuals now exist, emergency measures should be taken immediately to fence the remaining populations to protect them against further degradation by feral pigs. Once enclosed, these areas should undergo management to remove the alien plants, focusing on the following alien plants: thimbleberry, banana poka, prickly Florida blackberry, *Melastoma candidum*, fireweed, and daisy fleabane

Additional recovery actions, as discussed in the Stepdown Narrative of the Recovery Plan for the Kauai Plant Cluster, beginning on page 138 of the Plan, are also appropriate for this species.

Pritchardia napaliensis Recovery Priority 5

(on USFWS scale of 1-18 (USFWS 1983) - See Appendix G of the Recovery Plan for the Kauai Plant Cluster.

Description and Taxonomy

Appendix J contains a line drawing of this taxon.

Harold St. John described *Pritchardia napaliensis* based upon a specimen collected by Charles Christensen on Kauai in 1976. He named this plant for the Na Pali Coast of Kauai where it was first collected (USFWS 1996).

Pritchardia napaliensis, a member of the palm family (Arecaceae), is a small palm with about 20 leaves and an open crown. The palm ranges from 4 to 6 meters (13 to 20 feet) tall and has a slender trunk measuring 18 to 20 centimeters (7 to 8 inches) in diameter. The green leaf blades are about 85 centimeters (33.5 inches) long and are almost flat (irrespective of the longitudinal folds). The lower leaf surface is covered with elliptic, pale, thin, flexible, and somewhat translucent scales with fringed margins. Upon maturity, the leaves are almost smooth and the leaf segments are lax, flexible, and droop with increasing age. The flowers are arranged in branched clusters about 14 centimeters (5.5 inches) long, which are equal or shorter in length than the leaf stalks. Each flower is associated with a small, bristly bract. Bracts associated with the flowers or flower stalks are sparsely and inconspicuously coated with scales, which are usually lost at maturity. The black fruits are 1.7 to 2.3 centimeters (0.7 to 0.9 inch) long, 1.4 to 1.8 centimeters (0.6 to 0.7 inch) in diameter, and inversely egg-shaped. This species is distinguished from others of the genus that grow on Kauai by having about 20 flat leaves with pale scales on the lower surface that fall off with age, inflorescences with hairless main axes, and globose fruits less than 3 centimeters (1.2 inches) long (USFWS 1996).

Life History

No life history information for this species is currently available.

Habitat Description

Pritchardia napaliensis typically grows in a wide variety of habitats ranging from lowland dry to mesic forests to montane wet forests dominated by lama and sometimes kukui, ohia, and uluhe from 150 to about 1,160 meters (500 to about 3,800 feet) elevation. Several associated plant species besides those mentioned above include hala pepe, kopiko, *Cordyline fruticosa* (ti), *Cheirodendron trigynum* (olapa), and *Ochrosia* sp. (holei) (USFWS 1996).

Historic and Current Ranges and Population Status (Appendix K-15)

Pritchardia napaliensis is known from three locations on the island of Kauai on State-owned land: Hoolulu and Waiahuakua Valleys in the Hono O Na Pali Natural Area Reserve and Alealau in Kalalau Valley (within or close to the boundaries of Hono O Na Pali Natural Area Reserve and Na Pali Coast State Park). This species is not known to occur anywhere else. The largest population in Hoolulu Valley contains between 60 and 80 plants and the 2 other populations each contain 3 or fewer plants, giving a total of fewer than 90 known individuals for this species (USFWS 1996).

Reasons for Decline and Current Threats

Major threats to *Pritchardia napaliensis* include habitat degradation and grazing by goats and pigs; seed predation by rats; competition with the alien plants air plant, daisy fleabane, lantana, *Psidium guajava* (common guava), and possibly ti; and a risk of extinction from naturally occurring events and from reduced reproductive vigor due to the small number of remaining populations and individuals (USFWS 1996).

Conservation Measures

One population of *Pritchardia napaliensis* in the Hono O Na Pali Natural Area Reserve has been fenced by the Kauai Division of Forestry and Wildlife (Alvin Kyono, Kauai DOFAW, personal communication 1997). This species has been successfully propagated and over 15 plants are in cultivation on the grounds of the National Tropical Botanical Garden (G. Ray, personal communication 1997). No additional species-specific conservation efforts have been undertaken. General conservation efforts for the Kauai II Plant Cluster taxa can be found in the Overall Conservation Efforts section of this plan.

Needed Recovery Actions

1) Remove alien plants inside completed enclosure.

The State has fenced the Hono O Na Pali Natural Area Reserve population to protect it from imminent destruction by goats and pigs. The enclosed area should be surveyed and managed to reduce the following alien plant species: air plant, daisy fleabane, lantana, common guava, and ti.

2) Reduce threats from rodent predation.

A management plan to control rats should be developed. This should include the use of the currently approved Diphacinone bait blocks and ultimately a more broad-scale method such as aerial dispersal of rodenticide.

3) Maintenance of adequate genetic stock.

Maintenance of adequate genetic stock *ex situ* should be continued. Additional wild seeds should be collected periodically until the cryopreservation method of long-term storage is perfected. This will insure that viable seed stock is available for outplanting.

Additional recovery actions, as discussed in the Stepdown Narrative of the Recovery Plan for the Kauai Plant Cluster, beginning on page 138 of the Plan, are also appropriate for this species.

Pritchardia viscosa Recovery Priority 5

(on USFWS scale of 1-18 (USFWS 1983) - See Appendix G of the Recovery Plan for the Kauai Plant Cluster.

Description and Taxonomy

No line drawing is available for *Pritchardia viscosa.*

Pritchardia viscosa was first described by Rock in 1921, based on a specimen he collected on Kauai a year earlier. The specific epithet refers to the very viscous inflorescence, calyx, and corolla (USFWS 1996).

Pritchardia viscosa, a member of the palm family, is a small palm 3 to 8 meters (10 to 26 feet) tall. The lower surface of the leaf blades is silvery grey and covered with small scales. The inflorescences are about the same length as the leaf stalks and consist of one to three loosely branched panicles, each about 15 to 20 centimeters (6 to 8 inches) long. The flowers occur in two opposite rows and are extremely sticky and shiny. The elliptic, pear-shaped fruit are up to 4 centimeters (1.6 inches) long and about 2.5 centimeters (1 inch) wide. This species differs from others of the genus that grow on Kauai by the degree of hairiness of the lower surface of the leaves and main axis of the flower cluster, and length of the flower cluster (USFWS 1996).

Life History

No life history information for this species is currently available.

Habitat Description

The plants are found in an ohia-uluhe lowland wet forest with associated plant species including aiea, ahakea, hame, hapuu, and kopiko (USFWS 1996).

Historic and Current Ranges and Population Status (Appendix K-16)

Historically, *Pritchardia viscosa* was known only from the 1920 collection from Kalihiwai Valley on the island of Kauai. It was not seen again until 1987, when Robert Read observed it in the same general area as Rock's type locality, off the Powerline Road at 510 meters (1,680 feet) elevation on State land. This population of two juvenile and two mature plants comprises the only known extant individuals; three additional plants from this population were destroyed by Hurricane Iniki in 1992 (USFWS 1996; T. Flynn, personal communication 1997).

Reasons for Decline and Current Threats

Strawberry guava and alien grasses such as Hilo grass are major threats to *Pritchardia viscosa* because these alien plants are effective competitors for space, light, nutrients, and water. Rats eat the fruit of *Pritchardia viscosa* and are, therefore, a serious threat to the reproductive success of this species. At least one of the remaining mature trees has been damaged by spiked boots used either by a botanist or seed collector to scale these trees. Also, because of the small numbers of individuals in the only known population, this species is susceptible to extinction because a single naturally occurring event (e.g., a hurricane) could destroy all remaining plants (USFWS 1996).

Conservation Measures

This species has been successfully propagated from seed and tissue culture and 20 plants are presently in cultivation (G. Ray, personal communication 1997). No additional species-specific conservation efforts have been undertaken. General conservation efforts for the Kauai II Plant Cluster taxa can be found in the Overall Conservation Efforts section of this plan.

Needed Recovery Actions

1) Construct enclosure to protect against feral ungulates and control alien plant species.

Emergency measures should be taken immediately to fence the remaining individual to protect it against further degradation by feral pigs. Once enclosed, this area should undergo management to remove the alien plants, such as Hilo grass and strawberry guava.

2) Reduce threats from rodent predation.

A management plan to control rats should be developed. This should include the use of the currently approved Diphacinone bait blocks and ultimately a more broad-scale method such as aerial dispersal of rodenticide.

3) Maintenance of adequate genetic stock.

Maintenance of adequate genetic stock *ex situ* should be continued. Additional wild seeds should be collected periodically until the cryopreservation method of long-term storage is perfected. This will insure that viable seed stock is available for outplanting.

Additional recovery actions, as discussed in the Stepdown Narrative of the Recovery Plan for the Kauai Plant Cluster, beginning on page 138 of the Plan, are also appropriate for this species.

Schiedea helleri Recovery Priority 5
(on USFWS scale of 1-18 (USFWS 1983) - See Appendix G of the Recovery Plan for the Kauai Plant Cluster.

Description and Taxonomy

No line drawing is available for *Schiedea helleri*.

In 1895, Heller collected a plant specimen on Kauai that Sherff later named *Schiedea helleri* in honor of its collector. Listed as possibly extinct in the current treatment of the family, *Schiedea helleri* was recently collected on Kauai by botanists from the National Tropical Botanical Garden (USFWS 1996).

Schiedea helleri, a member of the pink family, is a vine. The stems, smooth below and minutely hairy above, are probably prostrate and at least 0.15 meter (0.5 foot) long with internodes at least 4 to 15 centimeters (1.6 to 6 inches) long. The opposite leaves are somewhat thick and range from 10 to 14 centimeters (4 to 5.5 inches) long and 4.5 to 6 centimeters (1.8 to 2.4 inches) wide. The leaves are triangular, egg-shaped to heart-shaped, conspicuously three-veined, and nearly hairless to sparsely covered with short, fine hairs, especially along the margins. The perfect flowers occur in loose, open branched clusters, each branch being 20 to 26 centimeters (8 to 10.2 inches) long. The flower contains 3 styles and probably 10 stamens. The fruits are capsules, about 3 to 3.4 millimeters (0.12 to 0.13 inch) long. This species differs from others of the genus that grow on Kauai by its viney habit (USFWS 1996).

Life History

Three plants were observed flowering by botanists from the National Tropical Botanical Garden in February 1995 (Steve Perlman, NTBG Provenance Report 1995). No additional life history information for this species is currently available.

Habitat Description

Schiedea helleri is found on steep cliffs in closed ohia-uluhe montane wet forest on State-owned land, within or close to the Alakai Wilderness Preserve, at approximately 1,070 meters (3,500 feet) elevation. Other native plants growing in association with this population include hapuu, kanawao, olapa, *Cyanea hirtella* (haha), *Dianella sandwicensis* (ukiuki), and *Viola wailenalenae*. The federally endangered *Poa sandvicensis* is also found here (USFWS 1996).

Historic and Current Ranges and Population Status (Appendix K-17)

Schiedea helleri was originally found only at a single location above Waimea, at Kaholuamano on the island of Kauai, collected 100 years ago . In 1993, this species was discovered on a steep wall above a side stream off Mohihi Stream, approximately 5.6 kilometers (3.5 miles) north of the original location. This population consists of 30 to 40 mature individuals found on a steep cliff in closed ohia-uluhe montane wet forest on State-owned land, within or close to the Alakai Wilderness Preserve, at approximately 1,070 meters (3,500 feet) elevation. Recently, a small population of 10 plants was discovered along the Mohihi-Waialeale Trail, and three plants were found in Nawaimaka Valley (K. Wood and S. Perlman, personal communication 1997).

Reason for Decline and Current Threats

Competition with the noxious alien plant prickly Florida blackberry and a risk of extinction from naturally occurring events and from reduced reproductive vigor due to the small number of extant individuals, are serious threats to *Schiedea helleri*. Pigs have not yet been reported from this drainage, but pose a potential threat since they are found in nearby areas (USFWS 1996).

Conservation Measures

Seeds and cuttings were collected by the National Tropical Botanical Garden but did not survive (Gary Ray, personal communication 1997). No additional species-specific conservation efforts have been undertaken. General conservation efforts for the Kauai II Plant Cluster taxa can be found in the Overall Conservation Efforts section of this plan.

Needed Recovery Actions

1) Maintenance of adequate genetic stock.

In order to prevent this taxon from going extinct, propagation efforts and the maintenance of adequate genetic stock *ex situ* should be continued. Additional wild seeds should be collected periodically until the cryopreservation method of long-term storage is perfected. This will insure that viable seed stock is available for outplanting.

2) Monitor status and threats and look for additional populations.

Monitoring of the existing population and attempts to find further populations should be undertaken. This work presents practical difficulties due to the location of one of the largest populations on a steep cliff off Mohihi Stream. Because of the habitat that the *Schiedea helleri* prefers, monitoring populations using rock-climbing techniques could cause damage to the fragile vegetation. Therefore, care must be taken not to damage cliff vegetation.

3) Surveys for appropriate outplanting sites and outplanting.

Outplanting using collected seeds should be attempted immediately after further surveys are conducted to identify appropriate areas. These surveys should focus on the following areas where the *Schiedea helleri* are currently and historically found: steep cliff off Mohihi Stream and along the Mohihi Waialeale Trail and Nawaimaka Valley.

Additional recovery actions, as discussed in the Stepdown Narrative of the Recovery Plan for the Kauai Plant Cluster, beginning on page 138 of the Plan, are also appropriate for this species.

***Schiedea kauaiensis* Recovery Priority 5**

(on USFWS scale of 1-18 (USFWS 1983) - See Appendix G of the Recovery Plan for the Kauai Plant Cluster.

Description and Taxonomy

No line drawing is available for *Schiedea kauaiensis*.

First collected near Papaa on Kauai by Otto Degener and Amy Greenwell in 1952, *Schiedea kauaiensis* was described by St. John in 1988. The authorities on this endemic Hawaiian genus, Stephen Weller, Ann Sakai, and Warren Wagner, accept *Schiedea kauaiensis* as a distinct species (S. Weller, *in litt.* 1994, 1995). Other published names considered synonymous with *Schiedea kauaiensis* include *Schiedea nuttallii* var. *pauciflora* and *Schiedea wichmanii* (S. Weller, *in litt.* 1994).

Schiedea kauaiensis, a member of the pink family, is a generally hairless, erect subshrub, with stems normally 0.3 to 1.5 meters (1 to 5 feet) long. The green, sometimes purple-tinged leaves are opposite, narrowly egg-shaped or lance-shaped to narrowly or broadly elliptic, up to 13 centimeters (5 inches) long, and 3.5 centimeters (1.4 inches) wide. The petalless, perfect flowers are borne in open branched inflorescences, moderately covered with fine, short, curly, white hairs. The lance-shaped sepals, 2 to 3.8 millimeters (0.08 to 1.5 inches) long, are green or sometimes purple-tinged. The fruit is a capsule. The round to kidney-shaped seeds are about 2 millimeters (0.08 inch) long. This species is distinguished from others in this endemic Hawaiian genus by its habit, larger leaves, the hairiness of the inflorescence, the number of flowers in each inflorescence, larger flowers, and larger seeds (Wagner *et al.* 1990; S. Weller, *in litt.* 1994).

Life History

Little is known about the life history of this taxon. Fruit and flowers have been observed in July and August, and flowering material has been collected in September (S. Weller *in litt.* 1994).

There is no evidence of regeneration from seed under field conditions. Seedlings of species of *Schiedea* occurring in mesic or wet sites are apparently consumed by introduced slugs and snails. These have been observed feeding on *Schiedea membranacea*, another mesic forest species that occurs on Kauai. In contrast to mesic-forest species, *Schiedea* occurring in dry areas produce abundant seedlings following winter rains, presumably because there are fewer alien consumers in the drier sites (S. Weller, personal communication 1997).

Reproductive cycles, longevity, specific environmental requirements and limiting factors are unknown.

Habitat Description

Schiedea kauaiensis typically grows in diverse mesic to wet forest on steep slopes. Associated plant taxa include *Psychotria hexandra* (kopiko), *Exocarpus luteolus* (heau), lama, the federally threatened *Peucedanum sandwicense* (makou), and the federally endangered *Euphorbia haeleeleana* (akoko) (USFWS 1996a; S. Weller, *in litt.* 1994).

Historic and Current Ranges and Population Status (Appendix K-18)

Historically *Schiedea kauaiensis* was known from the northwestern side of Kauai, from Papaa to Mahanaloa. It was thought to be extinct until the two currently known populations were found, which total about 15 plants. Both populations occur on State land--the Mahanaloa Valley population within Kuia NAR and the Kalalau Valley population within Na Pali Coast State Park (USFWS 1996a; USFWS *in litt.* 1997; S. Perlman, personal communication 1996) .

Reasons for Decline and Current Threats

Threats to *Schiedea kauaiensis* include habitat degradation and/or destruction by feral pigs, goats, and deer; competition from several alien plant taxa; predation by introduced slugs and snails, landslides; and a risk of extinction from naturally occurring events and/or reduced reproductive vigor due to the low number of individuals in only two known populations. *Schiedea kauaiensis* is also potentially threatened by fire (USFWS 1996a; S. Weller, personal communication 1997).

Conservation Measures

Both populations are found in State managed areas: Kuia NAR and the Na Pali Coast State Park. No specific conservation actions are known for this taxon.

Needed Recovery Actions

1) Construction of enclosures to protect populations against feral and wild ungulates.

Enclosures should be constructed around the two known populations of *Schiedea kauaiensis* to reduce impacts from ungulates. Subsequent control or removal of ungulates from these areas will alleviate their impact on native ecosystems. Commitments should be developed for long-term stewardship and conservation of these areas once they have been enclosed.

2) Development of management plans to control competing alien plant species.

A long-range management plan to control alien plants such as *Erigeron* sp., *Rubus* sp., and air plant should be developed.

3) Maintenance of adequate genetic stock.

In order to prevent extinction of this species, *ex situ* propagation should be initiated. Specific efforts should be made to immediately collect propagation material from both populations.

4) Enhancement of wild populations and establishment of new populations.

Once adequate propagated material is available, and fencing and weed control are underway in the areas of *in situ* populations, enhancement of these wild populations by outplanting should occur. Establishment of new populations within the historic range of *Schiedea kauaiensis* should be initiated in areas free from the impacts of feral ungulates and alien plants.

5) Control of introduced snails and slugs.

Control of introduced snails and slugs is essential for protection of this species. This species reproduces prolifically under greenhouse conditions. The lack of seedlings in the field seems, therefore, almost certainly to be the result of grazing. Evidence for other species of *Schiedea* that occur in mesic areas suggests that these alien species consume essentially all seeds, and probably a substantial portion of the seed crop. Methods to control their predation on seeds and/or seedlings of this species need to be determined and implemented (S. Weller, personal communication 1997).

6) Research on pollinators.

Research on pollinators is necessary because of the possibility that declines in native pollinator fauna might increase levels of inbreeding, and result in the expression of inbreeding depression. Estimates on inbreeding depression for this species are not available (S. Weller, personal communication 1997).

Schiedea membranacea Recovery Priority 2

(on USFWS scale of 1-18 (USFWS 1983) - See Appendix G of the Recovery Plan for the Kauai Plant Cluster.

Description and Taxonomy

Appendix J contains a line drawing of this taxon.

Robert Hobdy collected a specimen of *Schiedea membranacea* on Kauai in 1969. Harold St. John later described and named the taxon. The specific epithet refers to the membranous texture of the leaves (USFWS 1996).

Schiedea membranacea, a member of the pink family, is a perennial herb. The unbranched, fleshy stems rise upwards from near the base and are somewhat sprawling. They are 0.5 to 1 meter (1.6 to 3.3 feet) long with internodes 6 to 12 centimeters (2.4 to 4.7 inches) long. During dry seasons, the plant dies back to a woody, short stem at or beneath the ground surface. The oppositely arranged leaves, 13 to 20 centimeters (5 to 8 inches) long and 5 to 8 centimeters (2 to 3.2 inches) wide, are broadly elliptic to egg-shaped, generally thin, have five to seven longitudinal veins, and are sparsely covered with short, fine hairs. The perfect flowers have no petals, are numerous, and occur in large branched clusters. The inflorescence are about 25 to 27 centimeters (10 to 10.6 inches) long. The purple, lance-shaped sepals are about 2 millimeters (0.08 inch) long and have thin, dry, membranous margins. The flowers contain 3 to 5 styles and probably 10 stamens. The capsular fruits, 2.5 to 3 millimeters (0.1 to 0.12 inch) long, are purple at the apex. This species differs from others of the genus that grow on Kauai by having five- to seven-nerved leaves and an herbaceous habit (USFWS 1996).

Life History

Schiedea membranacea appears to be a long-lived perennial. Plants marked in Mahanaloa Gulch in 1987 were alive in 1997, despite Hurricane Iniki. There was no evidence of recruitment in the population, despite the production of abundant seed during all years of observation (1987, 1994-1997). Introduced snails have been observed feeding on flowers and developing seed capsules, and garlic snails are common near the plants. It seems very likely that introduced molluscs are responsible for the failure of recruitment.

Under greenhouse conditions, this species, as well as other *Schiedea* species, is extremely sensitive to slugs and snails, further suggesting that the introduction of these alien species has had detrimental effects on *Schiedea* species in natural conditions.

Schiedea membranacea is extremely diverse at allozyme loci, based on observations of plants from Mahanaloa Gulch (mean number of alleles per locus+3.00; percentage of polymorphic loci=66.7; mean heterozygosity=0.366). As expected for a genetically diverse species, inbreeding depression is very high. In an artificial crossing program, the relative inbreeding depression averaged over 11 maternal parents was 0.73, suggesting that very few selfed progeny would survive to adulthood if germination were successful. Under current conditions of pollination, *Schiedea membranacea* is largely outcrossed, based on outcrossing rates of 0.925 in 1993 and 0.749 in 1994. Pollinators for *Schiedea membranacea* are unknown. No visitors have been seen during the daytime, and none were observed during one set of night observations (Steve Weller, University of California at Irvine, personal communication 1997).

Habitat Description

This species is typically found on cliffs and cliff bases in a wide variety of mesic to wet habitats between 520 and 1,160 meters (1,700 and 3,800 feet) elevation. The vegetation ranges from open to closed lowland to montane shrubland to forest communities with either a variety of canopy and understory species or dominated by kukui, mamaki, or ohia (USFWS 1996).

Historic and Current Ranges and Population Status (Appendix K-19)

Schiedea membranacea is known from six current populations on the western side of the island of Kauai: Mahanaloa-Kuia, Paaiki, Kalalau, Nualolo, Waimiha and Waialae valleys on State (including Kuia Natural Area Reserve and Na Pali Coast State Park) and privately owned land. This species is not known to have occurred at any other locations. Although the number of plants of this species remaining in Paaiki Valley is not known, about 200 to 250 individuals are known in the other 5 populations (USFWS 1996).

Reasons for Decline and Current Threats

Habitat degradation by feral ungulates (black-tail deer, goats, and pigs); competition with the alien plant species daisy fleabane, lantana, prickly Florida blackberry, thimbleberry, strawberry guava, *Ageratina riparia* (Hamakua pamakani), and banana poka; and landslides are the primary threats to *Schiedea membranacea* (USFWS 1996).

Based on observations indicating that snails and slugs may consume seeds and seedlings, it is likely that introduced molluscs represent a major threat to this species. Unless the cause for failure of recruitment is determined, this population will decline as adult individuals die. This species has survived to date only because adults are long-lived, but eventually, the adults in the population will succumb to various sources of mortality. More information is needed on pollinators, which currently appear to contribute to a high outcrossing rate. Loss of pollinators would lead to expression of inbreeding depression, and presumably the eventual decline of the population, should the conditions resulting in failure of germination be reversed (S. Weller, personal communication 1997).

Conservation Measures

This species has been successfully propagated by seed. Over 9,000 seeds are in storage and over 20 plants are in cultivation (G. Ray, personal communication 1997). No additional species-specific conservation efforts have been undertaken. General conservation efforts for the Kauai II Plant Cluster taxa can be found in the Overall Conservation Efforts section of this plan.

Needed Recovery Actions

1) Surveys in Paaiki Valley.

Surveys in Paaiki Valley should be conducted to determine how many individuals still exist in this area.

2) Construct enclosures and develop a management plan for these enclosures.

Because of the threat from feral ungulates, enclosures should be constructed around the existing populations. To insure that the enclosures are not threatened by landslides, the existing six populations should be evaluated and ranked according to landslide threat prior to construction of enclosures. Without this protection, this species will continue to decline due to degradation of habitat by feral pigs. Once enclosed, those areas should undergo management that targets the reduction and removal of the following alien plant species: daisy fleabane, lantana, prickly Florida blackberry, thimbleberry, strawberry guava, Hamakua pamakani, and banana poka.

3) Determine the cause of low recruitment in the natural populations.

Enclosures will protect adult plants from ungulate damage, but will not reverse the low germination observed in Mahanaloa Gulch, and presumably the eventual decline of this species. Therefore, experiments should be undertaken to determine if snails and slugs are the major cause of recruitment failure. Once this determination has been made, appropriate recommendations can be made for long term protection of this species.

4) Undertake research to determine the pollinator or pollinators of *Schiedea membranacea*.

Pollinators appear to be critical to the high outcrossing rate of this species, and if they were to decline, very high levels of inbreeding depression would be expressed. Any long-range recovery plan must take into account this possibility. Without any knowledge of the pollinators, it will be impossible to implement plans ensuring survival of this species. Observations should be carried out during the day and night, since *Schiedea lydgatei* is pollinated by night-flying moths and it seems likely that the same or similar insects pollinate *Schiedea membranacea*. Once pollinators have been identified, aspects of the management plan may be modified to ensure survival of the pollinating species as well.

Additional recovery actions, as discussed in the Stepdown Narrative of the Recovery Plan for the Kauai Plant Cluster, beginning on page 138 of the Plan, are also appropriate for this species.

Schiedea stellarioides Recovery Priority 2
(on USFWS scale of 1-18 (USFWS 1983) - See Appendix G of the Recovery Plan for the Kauai Plant Cluster.

Description and Taxonomy

No line drawing is available for *Schiedea stellarioides*.

Mann and Brigham first collected a specimen of *Schiedea stellarioides* in the mountains of Kauai between 1864 and 1865. Benedict Pierre George Hochreutiner and E.E. Sherff published several varieties of this species, characterized only by slight differences in leaf shape and size, which are not recognized in the current treatment of the family (USFWS 1996).

Schiedea stellarioides, a member of the pink family, is a slightly erect to prostrate subshrub 0.3 to 0.6 meter (1 to 2 feet) tall with branched stems and internodes generally 3.5 to 6.5 centimeters (1.4 to 2.5 inches) long. The opposite leaves are very slender to oblong-elliptic, 2.7 to 8.2 centimeters (1.1 to 3.2 inches) long, 0.2 to 1.3 centimeters (0.1 to 0.5 inch) wide, and one-veined. The perfect flowers lack petals and occur in open branched clusters. The inflorescence ranges from 15 to 32 centimeters (6 to 12.6 inches) long. The flower stalks are 7 to 10 millimeters (0.28 to 0.4 inch) long and the narrowly egg-shaped sepals are 2.9 to 3.3 millimeters (0.11 to 0.13 inch) long. The flowers contain 10 stamens, 3 styles, and a 2-lobed nectary. The capsular fruits are 2.2 to 3.4 millimeters (0.09 to 0.13 inch) long and contain tiny, dark brown, circular to kidney-shaped, slightly wrinkled seeds. This species is distinguished from others of the genus that grow on Kauai by the number of veins in the leaves, shape of the leaves, presence of a leaf stalk, length of the flower cluster, and shape of the seeds (USFWS 1996).

Life History

Plants were observed flowering by botanists from the National Tropical Botanical Garden in February 1995 (Steve Perlman, NTBG Provenance Report 1995). No additional life history information for this species is currently available.

Habitat Description

Schiedea stellarioides is found on steep slopes in a closed koa-ohia lowland to montane mesic forest between 610 and 1,120 meters (2,000 and 3,680 feet) elevation (USFWS 1996). Associated plant species include aalii, alani, ukiuki, *Bidens cosmoides* (poola nui), *Mariscus* sp., and *Styphelia tameiameiae* (pukiawe) (USFWS 1996).

Historic and Current Ranges and Population Status (Appendix K-20)

Historically, *Schiedea stellarioides* was found at the sea cliffs of Hanakapiai Beach, Kaholuamano-Opaewela region, the ridge between Waialae and Nawaimaka valleys, and Haupu Range on the island of Kauai. This species is now found only at the ridge between Waialae and Nawaimaka valleys on State land, just 0.8 kilometer (0.5 mile) northwest of the Kaholuamano-Opaewela region. This population of approximately 500 to 1,000 individuals is found on steep slopes in a closed koa-ohia lowland to montane mesic forest between 610 and 1,120 meters (2,000 and 3,680 feet) elevation. The plants are scattered in an approximately 2-kilometer (1.25-mile) by 0.3-kilometer (0.2-mile) area (USFWS 1996).

Reasons for Decline and Current Threats

The primary threats to this species include habitat degradation by feral ungulates (pigs and goats), direct destruction of plants by goats, competition with the alien plants molasses grass and prickly Florida blackberry, and a risk of extinction of the one remaining population from naturally occurring events (USFWS 1996).

Conservation Measures

The Division of Forestry and Wildlife and the U.S. Fish and Wildlife Service intend to fence the only known population of this species in 1998 to protect it from feral goats and pigs (Marie Bruegmann, personal communication 1997). This species has been successfully propagated from seed. Over 1,800 seeds are in storage and 4 plants are in cultivation at the National Tropical Botanical Garden (G. Ray, personal communication 1997). No additional species-specific conservation efforts have been undertaken. General conservation efforts for the Kauai II Plant Cluster taxa can be found in the Overall Conservation Efforts section of this plan.

Needed Recovery Actions

1) Maintenance of adequate genetic stock.

In order to prevent this taxon from going extinct, propagation efforts and the maintenance of adequate genetic stock *ex situ* should be continued. Additional wild seeds should be collected periodically until the cryopreservation method of long-term storage is perfected. This will insure that viable seed stock is available for outplanting.

2) Remove alien plants inside completed enclosures.

The Division of Forestry and Wildlife and the U.S. Fish and Wildlife Service intend to fence the only known population on the ridge between Waialae and Nawaimaka valley in 1998 to protect it from imminent destruction by feral ungulates. Once enclosed, this area should be surveyed and managed to reduce threats from the following invasive alien plant species: prickly Florida blackberry and molasses grass.

3) Undertake research to determine level of natural recruitment from seed in *Schiedea stellarioides*.

Enclosures will extend the life of adult plants, but if introduced snails and slugs are consuming seedlings, as in the case of *Schiedea membranacea*, the populations will decline even if protected from ungulates.

4) Research on pollinators.

The current high selfing rate in this species may result from the recent loss of native pollinators. If inbreeding depression is high in *Schiedea stellarioides*, as it is for every other species of *Schiedea* that has been investigated (7 in total), then the high selfing rate will be detrimental to the long term persistence of this species. In conjunction with observations of pollinators, an investigation of levels of inbreeding depression are necessary.

Additional recovery actions, as discussed in the Stepdown Narrative of the Recovery Plan for the Kauai Plant Cluster, beginning on page 138 of the Plan, are also appropriate for this species.

Viola kauaiensis var. *wahiawaensis* Recovery Priority 6
(on USFWS scale of 1-18 (USFWS 1983) - See Appendix G of the Recovery Plan for the Kauai Plant Cluster.

Description and Taxonomy

No line drawing is available for *Viola kauaiensis* var. *wahiawaensis*.

Charles Noyes Forbes collected a specimen of *Viola kauaiensis* var. *wahiawaensis* on Kauai in 1909. In 1920, he described the variety, naming it for Wahiawa Bog where it was first collected (USFWS 1996).

Viola kauaiensis var. *wahiawaensis*, a member of the violet family (Violaceae), is a perennial herb with upward curving or weakly rising, hairless, lateral stems about 10 to 50 centimeters (4 to 20 inches) long. The kidney- to heart-shaped leaves are usually 2 to 5 centimeters (0.8 to 2 inches) long and 3.5 to 6 centimeters (1.4 to 2.4 inches) wide, and widely spaced. The toothed leaf blades are unlobed or rarely three-lobed, hairless or covered with a few minute hairs, with a broadly wedge-shaped base. The solitary flowers are borne in the leaf axils. Two types of flowers are present. One is self-pollinating and does not open, while the other opens and requires cross-pollination. The flowers that open have hairless petals, which are white on the upper surface and purple or blue to white on the lower surface. These petals are narrowly spatula-shaped, the upper petals measuring about 15 to 19 millimeters (0.6 to 0.7 inch) long, the lateral ones about 18 to 23 millimeters (0.7 to 0.9 inch) long, and the lower ones about 18 to 23 millimeters (0.7 to 1 inch) long. The non-opening flowers usually occur on short lateral stems. Their greenish petals are hairless, the upper ones being three-lobed and about 1 to 1.6 millimeters (0.04 to 0.06 inch) long. The fruit is a deeply lobed capsule 8 to 13 millimeters (0.3 to 0.5 inch) long. Two varieties of this species are recognized, both occurring on Kauai: var. *kauaiensis* and var.

wahiawaensis. Variety *wahiawaensis* is distinguished by having broadly wedge-shaped leaf bases, whereas var. *kauaiensis* has heart-shaped to truncate leaf bases. The species is distinguished from others of the genus by its nonwoody habit, widely spaced leaves, and by having two types of flowers: conspicuous, open flowers and smaller, unopened flowers (USFWS 1996).

Life History

Five plants were seen flowering by botanists from the National Tropical Botanical Garden while conducting a bog survey in December 1994 (Steve Perlman, personal communication 1997). No additional life history information for this species is currently available.

Habitat Description

Viola kauaiensis var. *wahiawaensis* is found in open bog surrounded by low scrub of ohia, uluhe *Diplopterygium pinnatum* and ohia ha at about 640 meters (2,100 feet) elevation and in wet shrubland dominated by uluhe ground cover, with scattered ohia and *Syzygium* sp., at about 865 meters (2,840 feet) elevation (USFWS 1996).

Historic and Current Ranges and Population Status (Appendix K-20)

Viola kauaiensis var. *wahiawaensis* is known only from the Wahiawa Mountains of Kauai on privately owned land. This taxon is not known to have occurred beyond its current range. Fewer than 100 individuals are known to remain in Kanaele Swamp (often referred to as Wahiawa Bog), an open bog surrounded by low scrub of ohia, uluhe, and ohia ha at about 640 meters (2,100 feet) elevation. Another eight plants, still in the same population, are on a nearby ridge between Mount Kapalaoa and Mount Kahili in wet shrubland dominated by uluhe-*Diplopterygium pinnatum* ground cover, with scattered ohia and *Syzygium* sp., at about 865 meters (2,840 feet) elevation (USFWS 1996).

Reasons for Decline and Current Threats

The primary threats to *Viola kauaiensis* var. *wahiawaensis* are a risk of extinction from naturally occurring events and from reduced reproductive vigor due to the small number of existing populations and individuals, habitat degradation through the rooting activities of feral pigs, and competition with alien plants such as *Juncus planifolius* and *Pterolepis glomerata* (USFWS 1996). Additionally, overcollecting is also considered a threat (K. Wood and S. Perlman, personal communication 1997).

Conservation Measures

No species-specific conservation efforts have been undertaken. General conservation efforts for the Kauai II Plant Cluster taxa can be found in the Overall Conservation Efforts section of this plan.

Needed Recovery Actions

1) Maintenance of adequate genetic stock.

In order to prevent this taxon from going extinct, propagation efforts and the maintenance of adequate genetic stock *ex situ* should be continued. Additional wild seeds should be collected periodically until the cryopreservation method of long-term storage is perfected. This will insure that viable seed stock is available for outplanting.

2) Development of management plans to fence and control alien plant species.

A long-range management plan to fence and control alien plant species in the Wahiawa Mountains of Kauai needs to be developed. Because this land is privately owned, a commitment should be developed for long-term stewardship and conservation of these areas. Active management should include fencing and methods of controlling the following alien plants: *Juncus planifolius* and *Pterolepis glomerata*.

Additional recovery actions, as discussed in the Stepdown Narrative of the Recovery Plan for the Kauai Plant Cluster, beginning on page 138 of the Plan, are also appropriate for this species.

6. Overall Recovery Strategy

See page 23 of the Recovery Plan for the Kauai Plant Cluster (USFWS 1995). To ultimately recover the listed plant taxa in Hawaii, habitat must be protected and managed for natural expansion of the current populations, as well as reintroduction of these taxa into portions of former range. Habitats believed to be important for the recovery of listed species in Hawaii will be published by the

U.S. Fish and Wildlife Service in the Recovery Plan for Multi-Island Plants. Maps showing these habitat areas may be used by land owners and managers to identify priority areas for management and restoration and for wide-range planning purposes.

RECOVERY

1. Objectives

See page 131 of the Recovery Plan for the Kauai Plant Cluster for a general overview of the recovery objectives for these taxa and definitions of endangered and threatened species and populations.

The interim objective is to stabilize all existing populations of the Kauai II taxa. To be considered stable, each taxon must be managed to control threats (e.g., fenced) and be represented in an *ex situ* (such as a nursery or arboretum) collection. In addition, a minimum total of three populations of each taxon should be documented on Kauai. Each of these populations must be naturally reproducing and increasing in number, with a minimum of 25 mature individuals per population for long-lived perennials (*Hibiscadelphus woodii*, *Hibiscus waimeae* ssp. *hannerae*, *Kokia kauaiensis*, *Labordia tinifolia* var. *wahiawaensis*, *Myrsine linearifolia*, *Pritchardia napaliensis*, *Pritchardia viscosa*) and a minimum of 50 mature individuals per population for short-lived perennials (*Alsinidendron lychnoides*, *Alsinidendron viscosum*, *Cyanea recta*, *Cyanea remyi*, *Cyrtandra cyaneoides*, *Delissea rivularis*, *Phyllostegia knudsenii*, *Phyllostegia wawrana*, *Schiedea helleri*, *Schiedea kauaiensis*, *Schiedea membranacea*, *Schiedea stellarioides*, *Viola kauaiensis* var. *wahiawaensis*).

For downlisting, a total of five to seven populations of each taxon should be documented on Kauai where they now occur or occurred historically. Each of these populations must be naturally reproducing, stable or increasing in number, and secure from threats, with a minimum of 100 mature individuals per population for long-lived perennials and a minimum of 300 mature individuals per population for short-lived perennials. Each population should persist at this level for a minimum of 5 consecutive years before downlisting is considered.

For delisting, a total of 8 to 10 populations of each taxon should be documented on Kauai where they now occur or occurred historically. Each of these populations must be naturally reproducing, stable or increasing in number, and secure from threats, with a minimum of 100 mature individuals per population for long-lived perennials and a minimum of 300 mature individuals per population for short-lived perennials. Each population should persist at this level for a minimum of 5 consecutive years.

Because we have only limited knowledge of the life history of each of these taxa with respect to specific requirements for their short-term and long-term survival, only tentative criteria for stabilizing, downlisting, and delisting are established here. These criteria were formulated based on recommendations by the Hawaii and Pacific Plants Recovery Coordinating Committee, as well as the International Union for Conservation of Nature and Natural Resources' (IUCN's) draft red list categories (Version 2.2) and the advice and recommendations of various biologists and knowledgeable individuals.

Additional information is needed about each of the Kauai II Plant Cluster species so that more meaningful recovery criteria can be quantified.

2. Stepdown Outline

See page 135 of the Recovery Plan for the Kauai Plant Cluster.

3. Stepdown Narrative

The Stepdown Narrative beginning on page 138 of the Recovery Plan for the Kauai Plant Cluster is applicable to the Kauai II Plant Cluster taxa.

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IMPLEMENTATION SCHEDULE

All agencies, landowners and land managers with responsibilities for plant species in the Kauai II Addendum were identified in the implementation schedule for the Recovery Plan for the Kauai Plant Cluster. Many of these taxa occur in the same general areas, they suffer from the same threats, and require the same recovery efforts.

The Implementation Schedule that follows outlines actions and estimated cost for the recovery program for the Kauai Plant Cluster and the Kauai II Cluster, as set forth in the recovery plan and this addendum. It is a guide for meeting the objectives discussed in Part II of the Recovery Plan for the Kauai Plant Cluster. This schedule indicates task priority, task numbers, task descriptions, duration of tasks, the agencies responsible for committing funds, and lastly, estimated costs. The agencies responsible for committing funds are not, necessarily, the entities that will actually carry out the tasks. When more than one agency is listed as the responsible party, an asterisk is used to identify the lead entity.

The actions identified in the implementation schedule, when accomplished, should protect habitat for the species, stabilize the existing populations and increase the population sizes and numbers. Monetary needs for all parties involved are identified to reach this point, whenever feasible.

Priorities in Column 1 of the following implementation schedule are assigned as follows:

Priority 1	-	An action that must be taken to prevent extinction or to prevent the species from declining irreversibly.
Priority 2	-	An action that must be taken to prevent a significant decline in species population or habitat quality, or some other significant negative impact short of extinction.
Priority 3	-	All other actions necessary to provide for full recovery of the species.

Key to Acronyms Used in Implementation Schedule

BOT - Various Botanical Gardens (e.g., National Tropical Botanical Garden, Lyon Arboretum, Waimea Botanical Garden, etc.)

BRD - Biological Resources Division - USGS

C - Once started, these actions will continue through recovery

C&CH - The City & County of Honolulu

DLNR - Department of Land and Natural Resources, Hawaii (includes Division of Forestry and Wildlife (DOFAW) and Division of State Parks (DOSP))

ES - U.S. Fish & Wildlife Service, Ecological Services, Honolulu, Hawaii

HDOA - State of Hawaii, Dept. of Agriculture

HHL - Hawaiian Home Lands

KCFD - Kauai County Fire Dept.

MCFD - Maui County Fire Dept.

NPS - National Park Service

OTHER - Various private landowners

TBD - To be determined at a later date

TNCH - The Nature Conservancy of Hawaii

WS - U.S. Dept. of Agriculture, Wildlife Services

RECOVERY TASK IMPLEMENTATION SCHEDUALE FOR THE KAUAI PLANT CLUSTER

PRIORITY NUMBER	TASK NUMBER	TASK DESCRIPTION	TASK DURATION (YRS)	RESPONSIBLE PARTY	TOTAL COST thru 2019	COST ESTIMATES ($1,000'S)						
						FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	FY 2004
Protect habitat:												
1	111	Identify and map all extant wild populations	5	* DLNR	385.1		50	50	50	77	77	27
				ES	77		10	10	10	15.4	15.4	5.4
				TNCH	77		10	10	10	15.4	15.4	5.4
1	112	Identify areas for preservation	3	* DLNR	23.1		5	5	5	2.7	2.7	2.7
				ES	4.6		1	1	1	0.5	0.5	0.5
				TNCH	4.6		1	1	1	0.5	0.5	0.5
1	113	Ensure long-term protection of habitat	2	* ES	38.4		12.5	12.5		6.7	6.7	
				DLNR	30.1		9.75	9.75		5.3	5.3	
				NPS	0.78		0.25	0.25		0.14	0.14	
				C&CH	0.78		0.25	0.25		0.14	0.14	
				TNCH	0.78		0.25	0.25		0.14	0.14	
				OTHER	5.46		1.75	1.75		0.98	0.98	
				HHL	0.78		0.25	0.25		0.14	0.14	
Identify and control threats:												
1	121	Develop management plans for protected areas	5	*DLNR	192.5				25	25	25	38.5
				ES	77				10	10	10	15.4
				TNCH	38.5				5	5	5	7.7
				NPS	15				2	2	2	3

RECOVERY TASK IMPLEMENTATION SCHEDUALE FOR THE KAUAI PLANT CLUSTER

PRIORITY NUMBER	TASK NUMBER	TASK DESCRIPTION	TASK DURATION (YRS)	RESPONSIBLE PARTY	TOTAL COST thru 2019	COST ESTIMATES ($1,000'S)						
						FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	FY 2004
1	1221	Determine fencing strategy	2	* DLNR	77		25	25		13.5	13.5	
				ES	15.4		5	5		2.7	2.7	
				TNCH	6		2	2		1	1	
				NPS	3		1	1		0.5	0.5	
				BRD	3		1	1		0.5	0.5	
1	1222	Construct and maintain fencing	C	* DLNR	2,559			150	150	150	231	231
				ES	2,559			150	150	150	231	231
				NPS	135			7.5	7.5	7.5	11.5	11.5
				TNCH	311			15	15	15	23.1	23.1
1	1223	Remove ungulates from fenced areas	10	* DLNR	924				60	60	60	92.4
				ES	231				15	15	15	23.1
				NPS	30				2	2	2	3
				TNCH	77				5	5	5	7.7
1	1224	Monitor for ungulates in fenced areas	C	* DLNR	256.5					10	10	10
				ES	256.5					10	10	10
				NPS	13.5					0.5	0.5	0.5
				TNCH	13.5					0.5	0.5	0.5
1	123	Conduct essential alien plant control	C	* DLNR	2,043.7		30	130	130	146.3	199.8	169.3
				ES	1,813.2			100	100	100	153.7	153.7
				BRD	230.5		30	30	30	46.1	46.1	16.1
				NPS	91.1			5	5	5	7.7	7.7
				TNCH	208.7			10	10	10	15.4	15.4

RECOVERY TASK IMPLEMENTATION SCHEDUALE FOR THE KAUAI PLANT CLUSTER

PRIORITY NUMBER	TASK NUMBER	TASK DESCRIPTION	TASK DURATION (YRS)	RESPONSIBLE PARTY	TOTAL COST thru 2019	COST ESTIMATES ($1,000'S)						
						FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	FY 2004
1	124	Provide necessary fire protection	C	* DLNR	700.9		25	65	65	77.8	98.2	98.2
				ES	700.9		25	65	65	77.8	98.2	98.2
				KCFD	87.8		2.5	10.5	10.5	10.5	10.5	10.5
				MCFD	70.1		2.5	5.7	5.7	7	8.6	8.6
				TNCH	92		5	8.2	8.2	10.8	12.6	12.6
				NPS	126.3		2.5	10.5	10.5	16	16	16
1	1251	Control rodents	C	* DLNR	301.8			10.5	10.5	10.5	15.9	15.9
				ES	301.8			10.5	10.5	10.5	15.9	15.9
1	1252	Control slugs	C	*DLNR	150			5	5	5	7.7	7.7
				ES	150			5	5	5	7.7	7.7
1	1253	Control insects	TBD	* DLNR	0			TBD				
				ES	0			TBD				
				TNCH	0			TBD				
				NPS	0			TBD				
1	1254	Control red jungle fowl	C	*DLNR	57			2	2	2	3	3
				ES	57			2	2	2	3	3
1	126	Control disease, if necessary	TBD	* DLNR	0			TBD				
				ES	0			TBD				
				TNCH	0			TBD				
				NPS	0			TBD				
1	127	Ensure availability of pollinators if necessary	TBD	* DLNR	0			TBD				
				ES	0			TBD				
				TNCH	0			TBD				
				NPS	0			TBD				
1	128	Protect areas from direct threats from humans	C	* DLNR	476.7			68.4	68.4	10.5	45.5	45.5
				ES	476.7			68.4	68.4	10.5	45.5	45.5
				N/S	30			5.3	5.5	0.5	3.1	3.1
				TNCH	58.6			10.5	10.5	1	6.4	6.4

RECOVERY TASK IMPLEMENTATION SCHEDUALE FOR THE KAUAI PLANT CLUSTER

PRIORITY NUMBER	TASK NUMBER	TASK DESCRIPTION	TASK DURATION (YRS)	RESPONSIBLE PARTY	TOTAL COST thru 2019	COST ESTIMATES ($1,000'S)						
						FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	FY 2004
1	129	Maintain genetic stock ex situ	O	• DLNR	182.4	10	10	5	10.5	10.5	8	8
				ES	182.4	10	10	5	10.5	10.5	8	8
				NTBG	456	50	50	10	37	37	17	17
1	1211	Control other threats, as necessary	TBD	• DLNR	0	TBD						
				ES	0	TBD						
				NPS	0	TBD						
				TNCH	0	TBD						
1	13	Monitor status of wild populations	C	• DLNR	2,915			100	100	100	154	154
				ES	1,457.5			50	50	50	77	77
				TNCH	291.5			10	10	10	15.4	15.4
				NPS	145.8			5	5	5	7.7	7.7
2	1225	Consider ungulate eradication	2	•DLNR	15.4		5	5		2.7	2.7	
				ES	4		1	1		1	1	
2	1210	Prevent introduction of new alien species	O	• DLNR	90.3	2	2	2	3	3.1	3.1	3.1
				ES	90.3	2	2	2	3	3.1	3.1	3.1
				HDOA	90.3	2	2	2	3	3.1	3.1	3.1
NEED 1 (Protect habitat, control threats and monitor)					22,587.6	76	340.5	1,283	1,383.2	1,411.5	1,905.4	1,806.5
2	21	Identify populations for expansion	5	• DLNR	231		30	30	30	46.2	46.2	16.2
				ES	77		10	10	10	15.4	15.4	5.4
				BRD	231		30	30	30	46.2	46.2	16.2
2	22	Identify material to be used for expansion	5	• DLNR	154		20	20	20	30.8	30.8	10.8
				ES	38.5		5	5	5	7.7	7.7	2.7
				BRD	154		20	20	20	30.8	30.8	10.8
2	23	Determine propagation methods and propagate ex situ	O	• DLNR	5,987	350	500	500	689	770	770	615.8
				BOT	5,987	350	500	500	689	770	770	615.8
				ES	1,213	60	110	110	143.1	169	169	118.7

RECOVERY TASK IMPLEMENTATION SCHEDUALE FOR THE KAUAI PLANT CLUSTER

PRIORITY NUMBER	TASK NUMBER	TASK DESCRIPTION	TASK DURATION (YRS)	RESPONSIBLE PARTY	TOTAL COST thru 2019	COST ESTIMATES ($1,000'S)						
						FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	FY 2004
2	24	Prepare sites and plant	10	* DLNR	0			TBD				
				ES	0			TBD				
				TNCH	0			TBD				
				NPS	0			TBD				
2	25	Monitor and maintain new individuals	C	* DLNR	0				TBD			
				ES	0				TBD			
				TNCH	0				TBD			
				NPS	0				TBD			
NEED 2 (Expand current populations)												
					14,072.5	760	1,225	1,225	1,636.1	1,886.1	1,886.1	1,411.9
2	31	Study associated ecosystem components	10	*BRD	770		50	50	50	77	77	77
				DLNR	770		50	50	50	77	77	77
				ES	770		50	50	50	77	77	77
2	32	Map alien vegetation	C	*DLNR	460.8		15	15	15	23.1	23.1	23.1
				ES	307.4		10	10	10	15.4	15.4	15.4
				TNCH	460.8		15	15	15	23.1	23.1	23.1
				NPS	160		5	5	5	7.7	7.7	7.7
2	33	Study growth	10	*BRD	770		50	50	50	77	77	77
				ES	770		50	50	50	77	77	77
				DLNR	770		50	50	50	77	77	77
2	34	Study reproductive viability	10	*BRD	770		50	50	50	77	77	77
				ES	770		50	50	50	77	77	77
				DLNR	770		50	50	50	77	77	77
2	35	Determine parameters of viable populations	10	*BRD	770		50	50	50	77	77	77
				ES	770		50	50	50	77	77	77
				DLNR	770		50	50	50	77	77	77

RECOVERY TASK· IMPLEMENTATION SCHEDUALE FOR THE KAUAI PLANT CLUSTER

PRIORITY NUMBER	TASK NUMBER	TASK DESCRIPTION	TASK DURATION (YRS)	RESPONSIBLE PARTY	TOTAL COST thru 2019	COST ESTIMATES ($1,000'S)						
						FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	FY 2004
2	36	Determine threat from introduced organisms and disease	5	* DLNR	308		40	40	40	61.6	61.6	21.6
				ES	154		20	20	20	30.8	30.8	10.8
				HDOA	154		20	20	20	30.8	30.8	10.8
				BRD	308		40	40	40	61.6	61.6	21.6
2	37	Determine effective control methods for threats	5	* DLNR	0				TBD			
				BRD	0				TBD			
				ES	0				TBD			
				WS	0				TBD			
				HDOA	0				TBD			
2	38	Evaluate research results and use in future management	C	* DLNR	257.4				10	10	10	15.4
				ES	257.4				10	10	10	15.4
				BRD	257.4				10	10	10	15.4
				TNCH	27				1	1	1	1.5
				NPS	27				1	1	1	1.5
NEED 3 (Conduct essential research)					12,388.2	0	765	765	797	1,210.1	1,210.1	1,107.5
2	41	Identify reestablishment sites	5	* DLNR	500.5		65	65	65	100.1	100.1	35.1
				ES	115.5		15	15	15	23.1	23.1	8.1
				BRD	423.5		55	55	55	84.7	84.7	29.7
2	42	Protect reestablishment sites	2	* ES	0		TBD					
				DLNR	0		TBD					
				TNCH	0		TBD					
				NPS	0		TBD					
2	43	Identify material for reestablishment	5	* DLNR	38.5		5	5	5	7.7	7.7	2.7
				BRD	38.5		5	5	5	7.7	7.7	2.7
				ES	38.5		5	5	5	7.7	7.7	2.7

RECOVERY TASK IMPLEMENTATION SCHEDUALE FOR THE KAUAI PLANT CLUSTER

PRIORITY NUMBER	TASK NUMBER	TASK DESCRIPTION	TASK DURATION (YRS)	RESPONSIBLE PARTY	TOTAL COST thru 2019	COST ESTIMATES ($1,000'S)						
						FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	FY 2004
2	44	Determine propagation methods and propagate ex situ	O	* DLNR	0					TBD		
				BOT	0					TBD		
				ES	0					TBD		
2	45	Prepare sites and plant	10	* DLNR	0							TBD
				ES	0							TBD
				TNCH	0							TBD
				NPS	0							TBD
2	46	Monitor and maintain new populations	C	* DLNR	0							TBD
				ES	0							TBD
				TNCH	0							TBD
				NPS	0							TBD
NEED 4 (Reestablish in former range)												
					1,155	0	150	150	150	231	231	81
3	51	Determine number of populations needed for long term survival	3	*BRD	92.2							
				ES	92.2							
				DLNR	92.2							
3	52	Determine number of individuals needed for long term survival	3	*BRD	92.2							
				ES	92.2							
				DLNR	92.2							
3	53	Refine/revise downlisting and delisting criteria	3	* ES	61.5							
				DLNR	61.5							
NEED 5 (Validate recovery objectives)												
					676.2	0	0	0	0	0	0	0
3	6	Design and implement a education program	5	*DLNR	38.5		5	5	5	7.7	7.7	2.7
				ES	38.5		5	5	5	7.7	7.7	2.
NEED 6 (Design and implement public education program)												
					77	0	10	10	10	15.4	15.4	5.4
TOTAL COST												
					50,996.5	836.0	2,690.5	3,433.0	3,976.3	4,734.1	5,292.0	4,411.5

APPENDIX I
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Natural Area Reserve System
Kendall Building
888 Mililani St., Suite 700
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Ms. Betsy Harrison-Gagne
Dept. of Land and Natural Resources
Natural Area Reserve System
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Natural Area Reserve System
1151 Punchbowl St.
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Office of Hawaiian Affairs
711 Kapiolani Blvd., Suite 500
Honolulu, HI 96813

Chair, Board of Agriculture
Hawaii Dept. of Agriculture
1428 King St.
Honolulu, HI 96814

Land Use Commission
P.O. Box 2359
Honolulu, HI 96804-2359

Libraries

Hawaii State Library
478 South King Street
Honolulu, Hawaii 96813

Kauai Regional Library
4344 Hardy Ave.
Lihue, HI 96766

Counties

Mayor
County of Kauai
4396 Rice St.
Suite 101
Lihue, Hawaii 96766

Appropriate Fire Departments

Kauai County Fire Department
4444 Rice Street, Suite 295
Lihue, HI 96766

Other Interested Parties

Dr. Isabella Abbott
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3190 Maile Way
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Amy Greenwell Botanical Garden
P.O. Box 1050
Captain Cook, HI 96704

Mr. Steve Anderson
Resources Management
Haleakala National Park
P.O. Box 369
Makawao, HI 96768

Bishop Museum
Dept. of Botany
1525 Bernice St.
P.O. Box 19000A
Honolulu, HI 96817-0916

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Lawai, HI 96765

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Gardens
Kew, Richmond, Surrey
England, U.K. TW9 3AE

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Haleakala Station
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Makawao, HI 96768

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Conservation Council of Hawaii
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Honolulu, HI 96802

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Kauai Hunters Assoc.
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Washington, D.C. 20560

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Administrator of Agriculture
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Kapolei, HI 96707

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Director, Community Support
Kokee Natural History Museum
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Kekaha, HI 96752

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Head, Documents Dept.
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Colorado State University
Ft. Collins, CO 80523-1879

Secretariat for Conservation Biology
University of Hawaii at Manoa
Pacific Biomedical Research Center
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Honolulu, Hawaii 96822

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Dept. of Range Science
Colorado State Univ.
Ft. Collins, CO 80523

Mr. Michael Sherwood
Earthjustice
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San Francisco, CA 94109

Mr. John J. Sheehan
c/o Donn R. Campion
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Sunnyvale, CA 94086

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Honolulu, HI 96822

Dr. S.H. Sohmer
Director
Botanical Res. Institute of Texas
509 Pecan St.
Ft. Worth, TX 76102

Sierra Club
P.O. Box 2577
Honolulu, HI 96803

Jan Tenbruggencate
Honolulu Advertiser
P.O. Box 524
Lihue, HI 96766-0524

Mr. Tim Tunison
Hawaii Volcanoes National Park
P.O. Box 52
Hawaii Volcanoes National Park, HI
96718

University of Hawaii
Dept. of Botany
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Honolulu, HI 96822

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University of California, Irvine
Ecology && Evolutionary Biology
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Hanalei, HI 96714

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Honolulu, HI 97817

Ms. Alenka Remec
Director of Science and Stewardship
The Nature Conservancy of Hawaii
1116 Smith Street, Suite 201
Honolulu, HI 97817

Greg Koob
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Honolulu, HI 96828

TNC Preserves

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Director, Oahu and Lanai Preserves
The Nature Conservancy of Hawaii
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Honolulu, HI 97817

Mr. Ed Misaki
Director, Molokai Preserves
The Nature Conservancy of Hawaii
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Kualapuu, HI 96757

Mr. Mark White
Director, Maui Preserves
The Nature Conservancy of Hawaii
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81 Makawao Ave., Suite 203A
Makawao, Maui 96768

Appropriate Landowners/Managers

Trustees
Kamehameha Schools Bishop Estate
P.O. Box 3466
Honolulu, HI 96801

Department of Hawaiian Home
Lands
P.O. Box 1879
Honoululu, HI 96805

Mr. William Hyde Rice Ltd.
P.O. Box 1391
Lihue, HI 96766

Mr. Charles Wichman, Jr.
P.O. Box 753
Hanalei, HI 96714

Lihue Plantation Co., Ltd.
2970 Kele Street
Lihue, HI 96766

Gay and Robinson
P.O. Box 117
Makaweli, HI 96769

Grove Farm Co., Inc.
P.O. Box 2069
Lihue, HI 96766

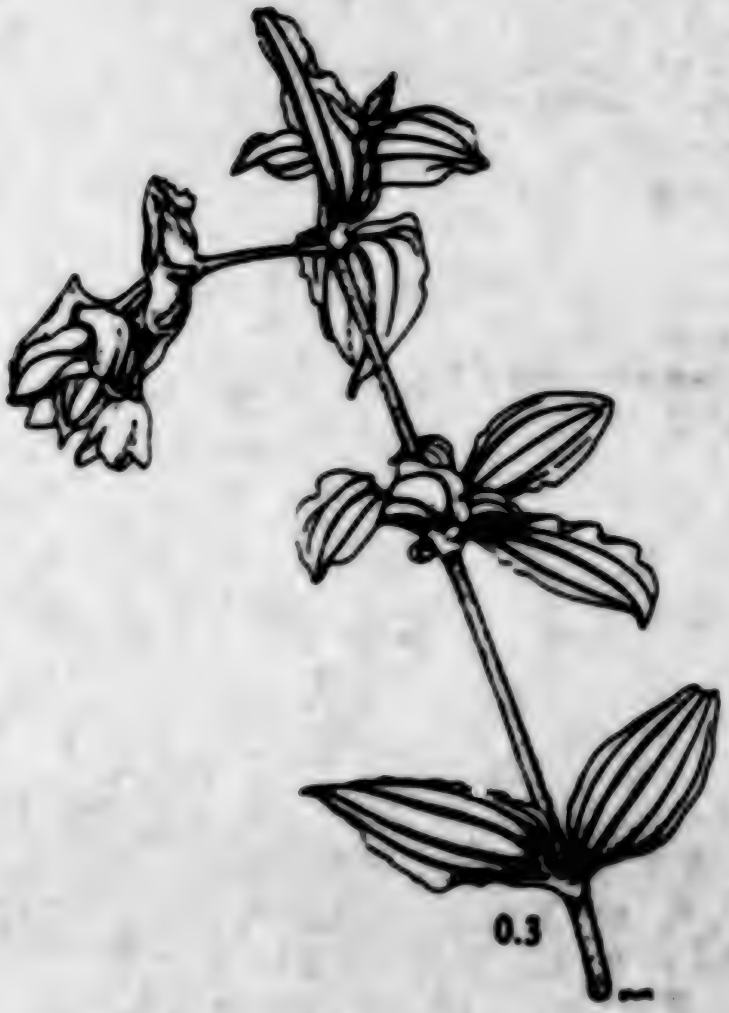
McBryde Sugar Company, Inc.
P.O. Box 8
Eleele, Hawaii 96705

(*) - Persons and Agencies who provided information necessary for the development of the Plan.
(**) - Personal communication recieved

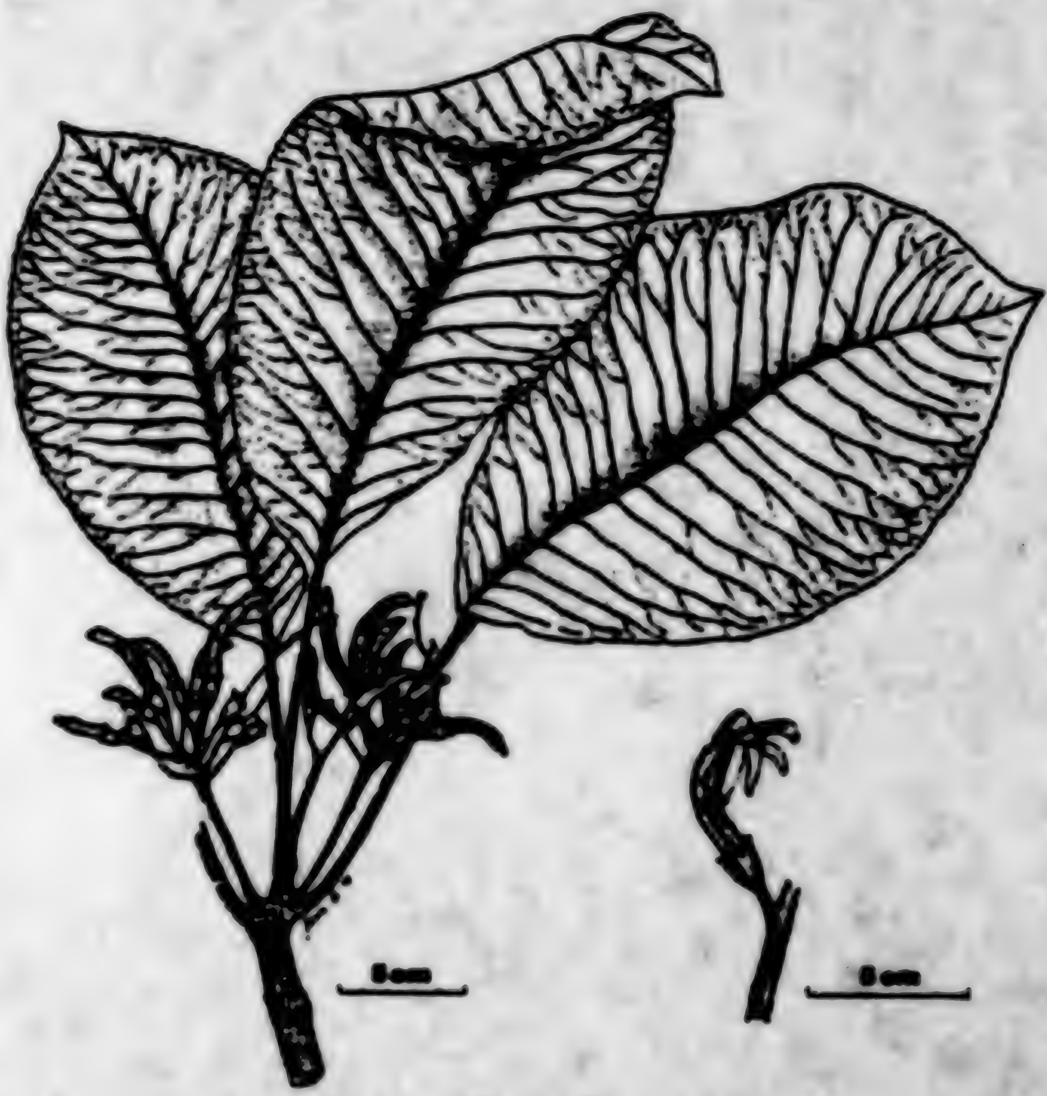
APPENDIX J
LINE DRAWINGS OF PLANTS

No line drawings were available for the following species:

Alsinidendron viscosum
Cyanea recta
Cyrtandra cyaneoides
Delissea rivularis
Hibiscus waimeae ssp. *hannerae*
Labordia tinifolia var. *wahiawaensis*
Phyllostegia knudsenii
Phyllostegia wawrana
Pritchardia viscosa
Schiedea helleri
Schiedea kauaiensis
Schiedea stellarioides
Viola kauaiensis var. *wahiawaensis*

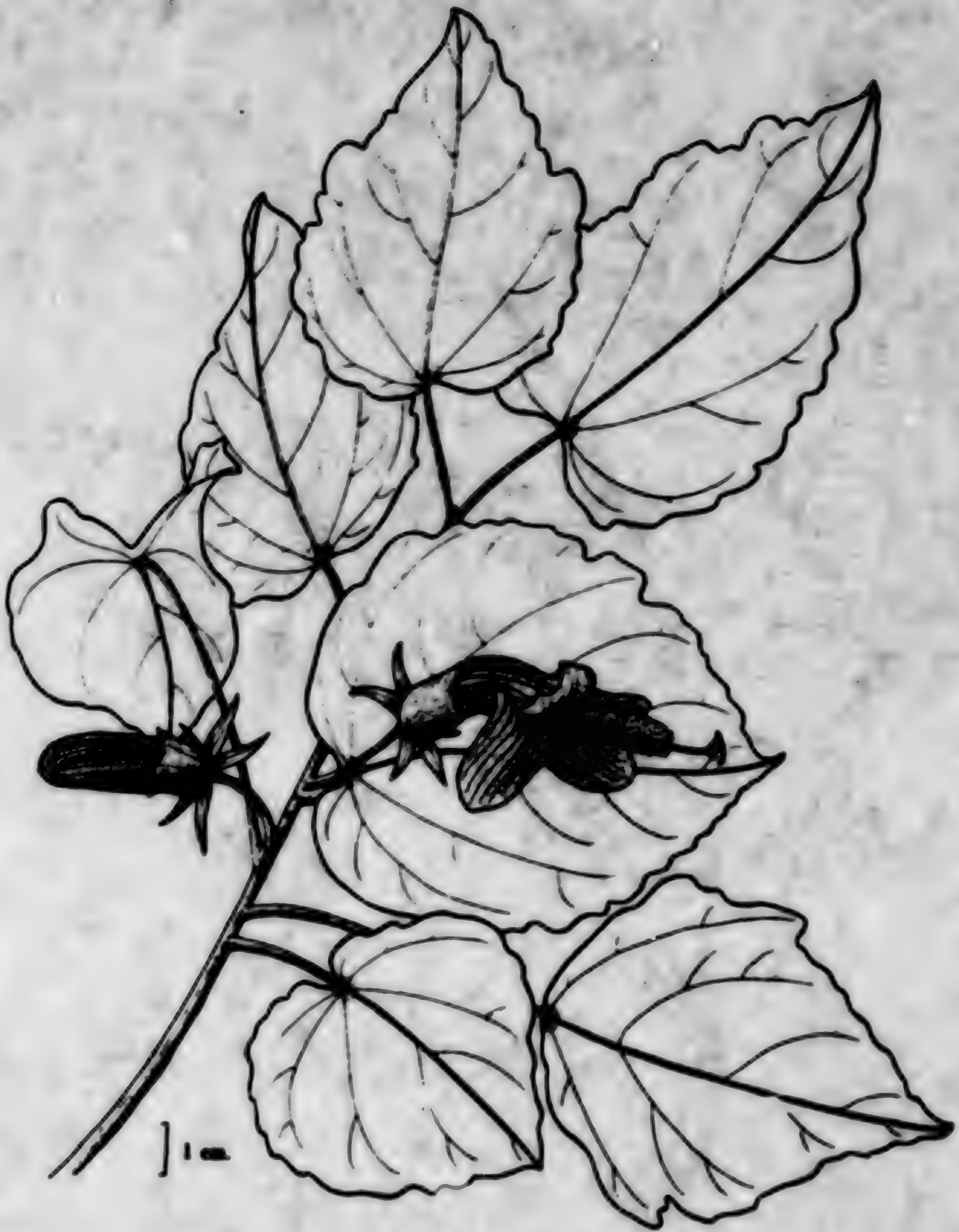


Line drawing of *Alsinidendron lychnoides* from Wagner et al. (1990).

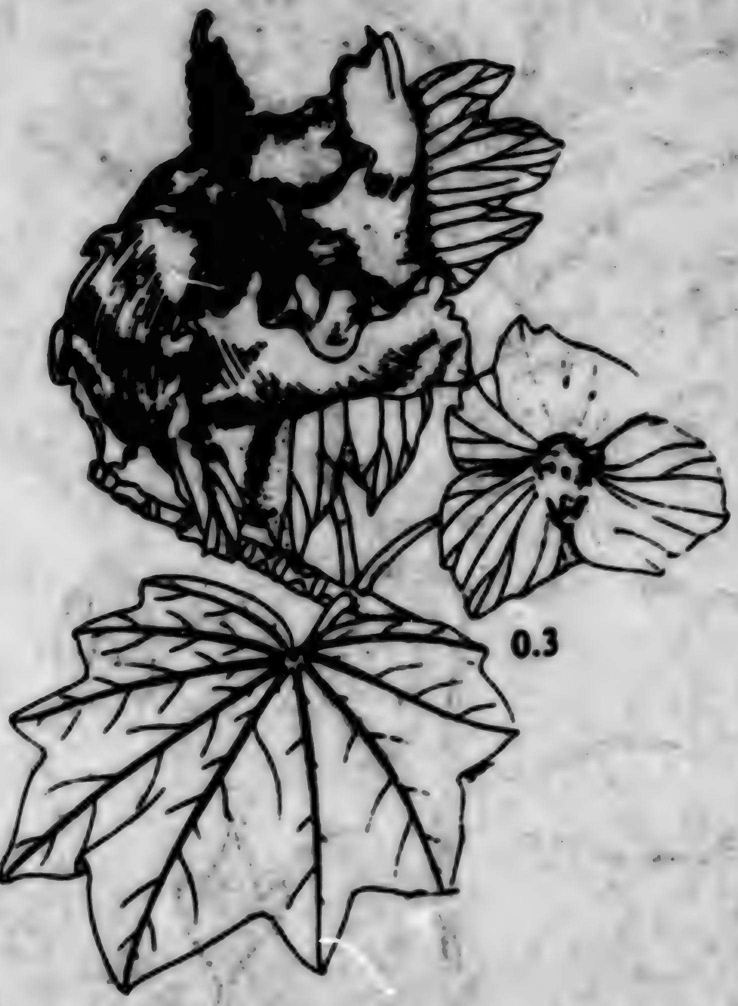


Line drawing of *Cyanea remyi* from Lammers and Lorence (1993).

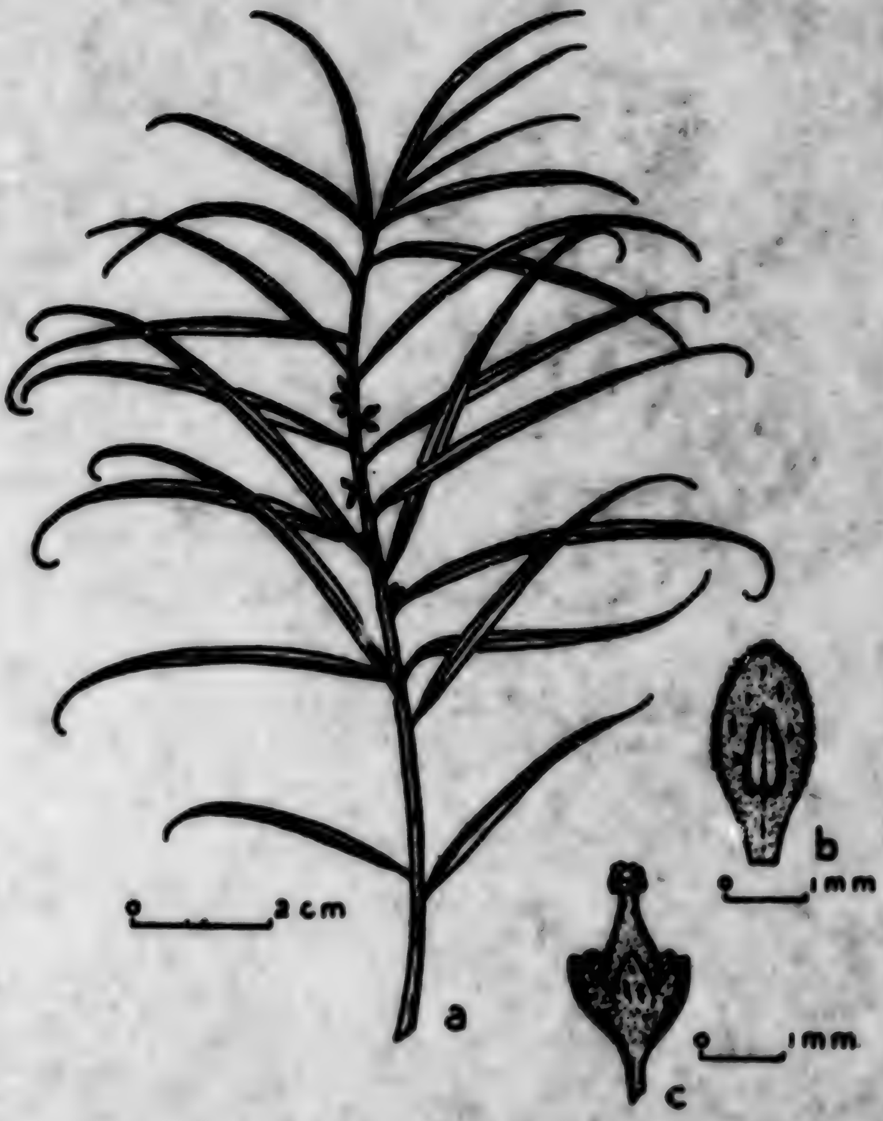
98



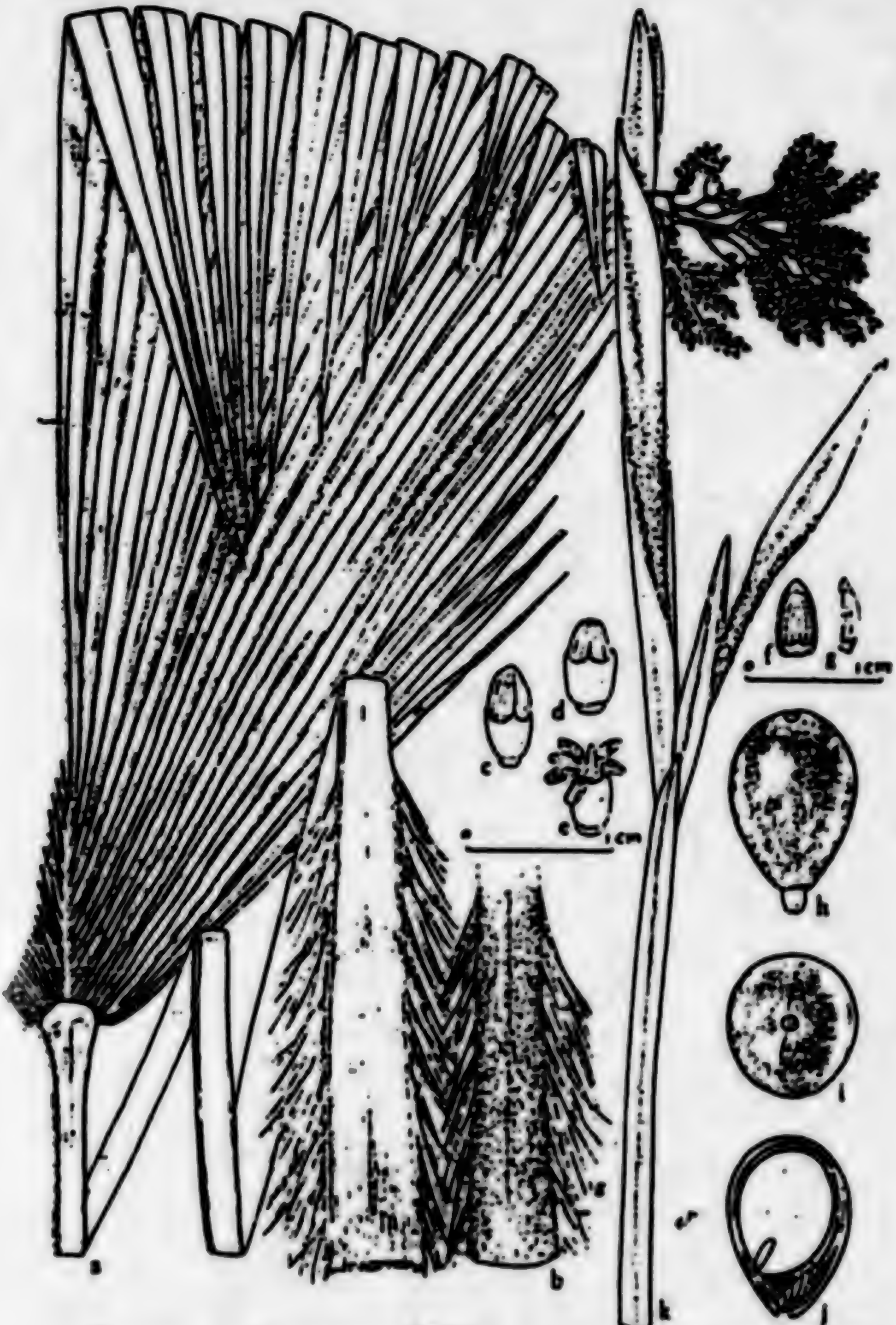
Line drawing of *Hibiscadelphus woodii* from Lorence and Wagner (1995).



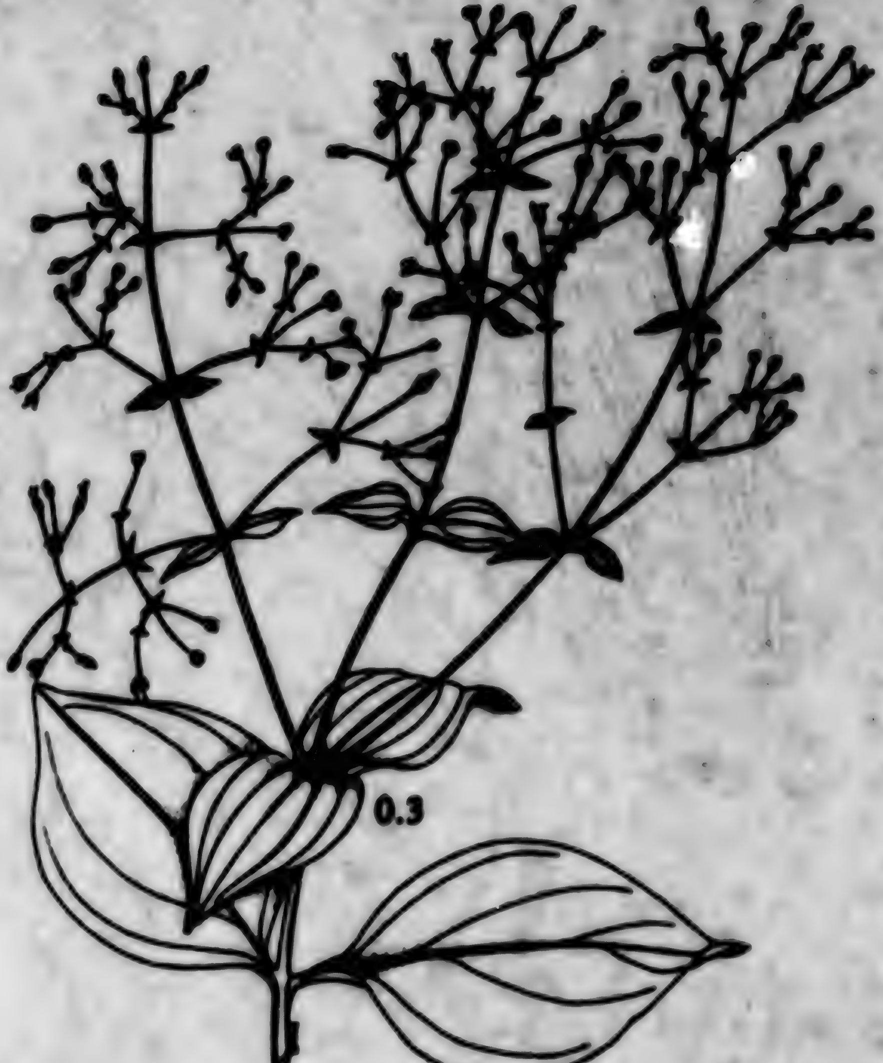
Line drawing of *Kokia kauaiensis* from Wagner et al. (1990).



Line drawing of *Myrsine linearifolia* from Hosaka (1940).



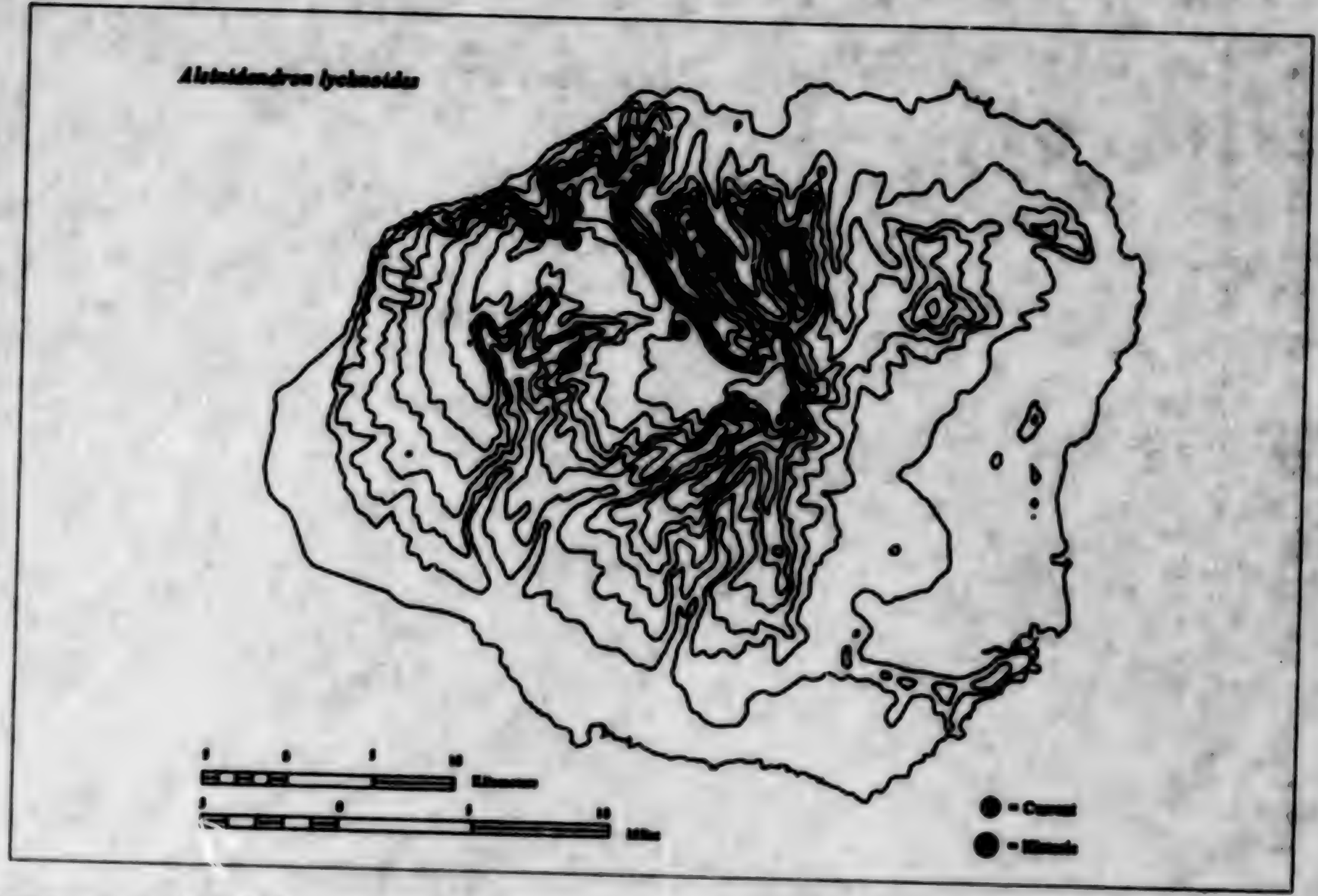
Line drawing of *Pritchardia napaliensis* from St. John (1981).



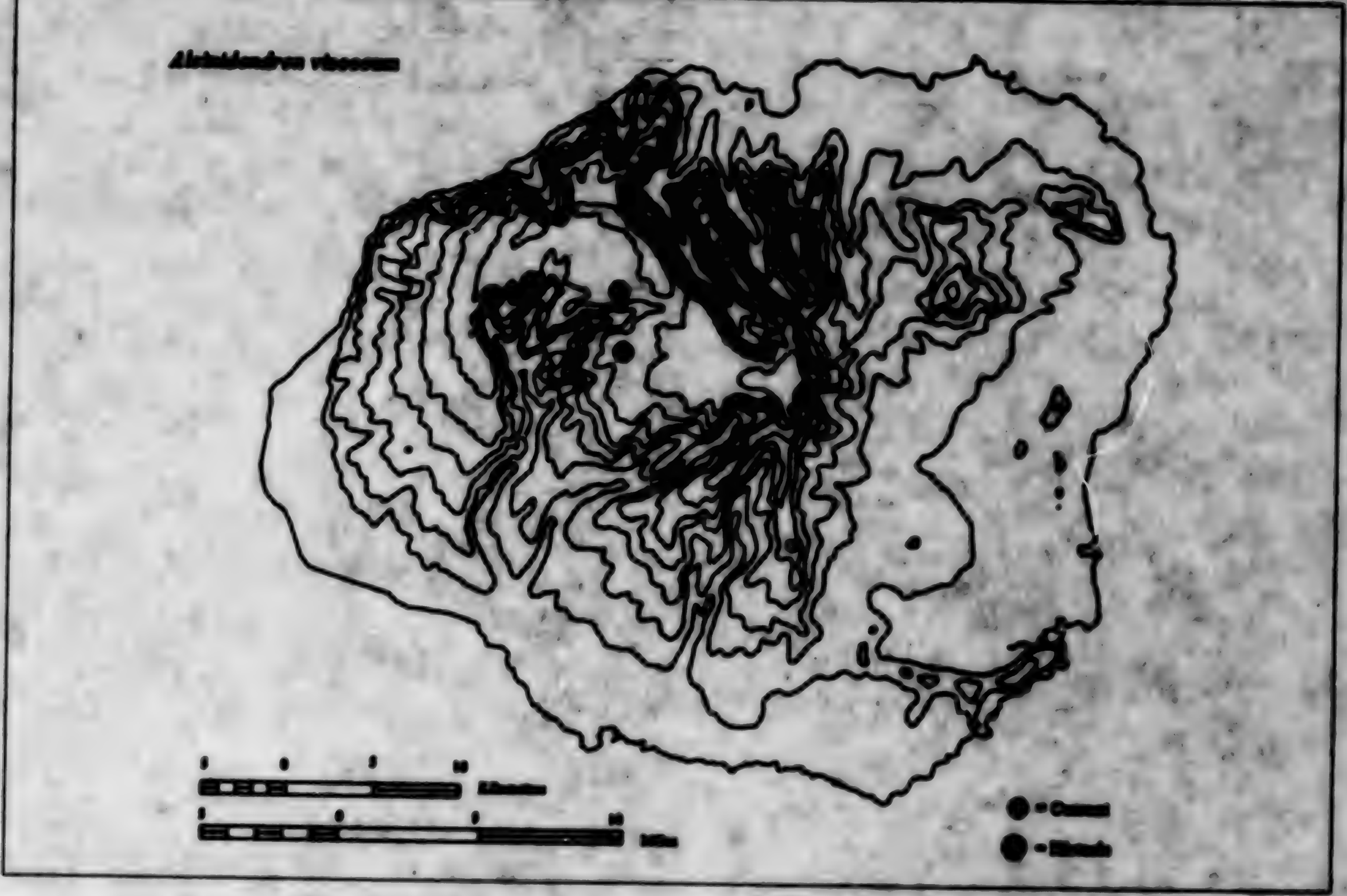
Line drawing of *Schiedea membranacea* from Wagner et al. (1990).

APPENDIX K
HISTORIC AND CURRENT DISTRIBUTION MAPS

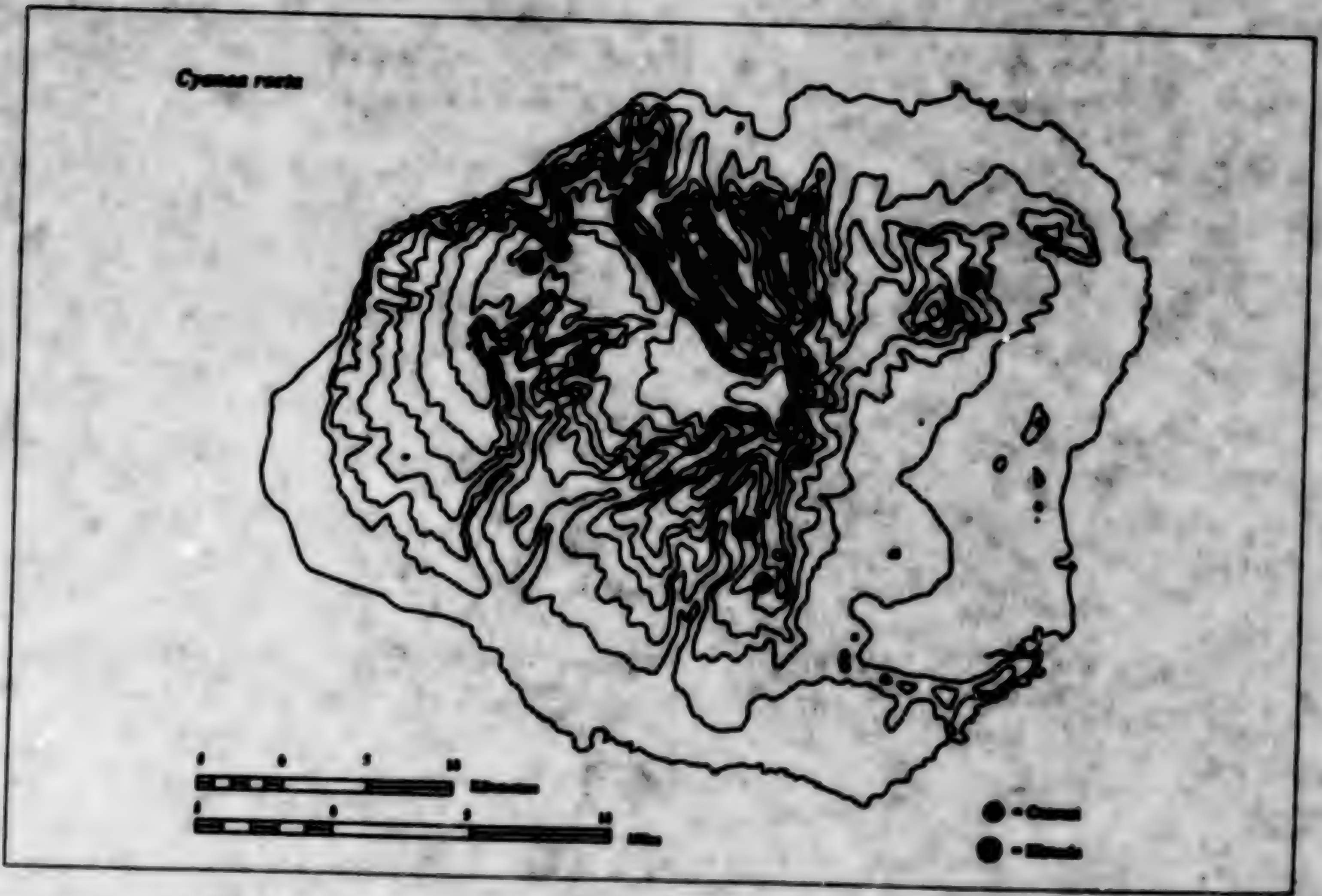
Historical distributions are estimates based on the best available information. For some species historical information is the same as current distribution.



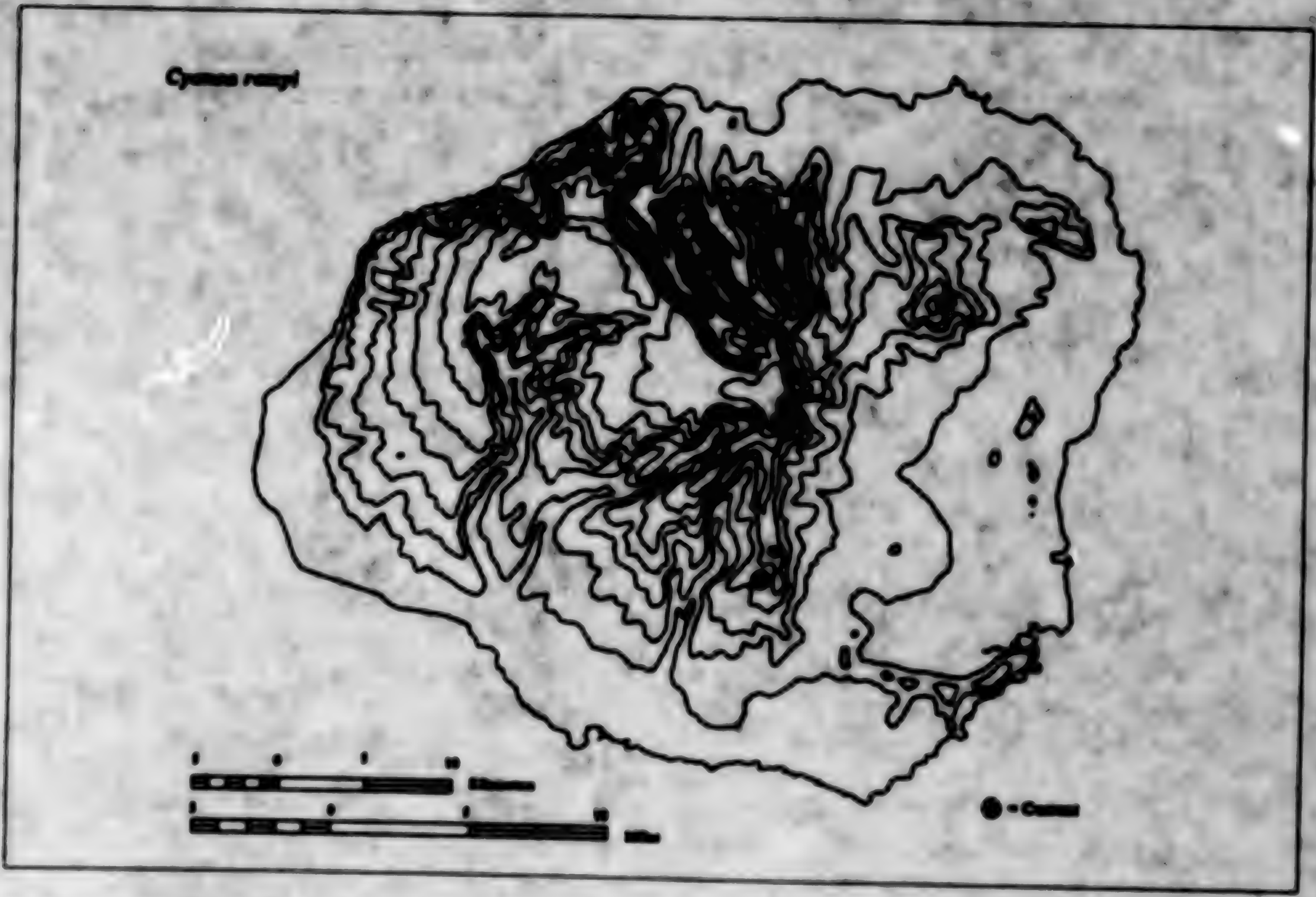
Current range and historical occurrences of *Alsinidendron lychnoides* (kuawawaenohu) on Kauai.



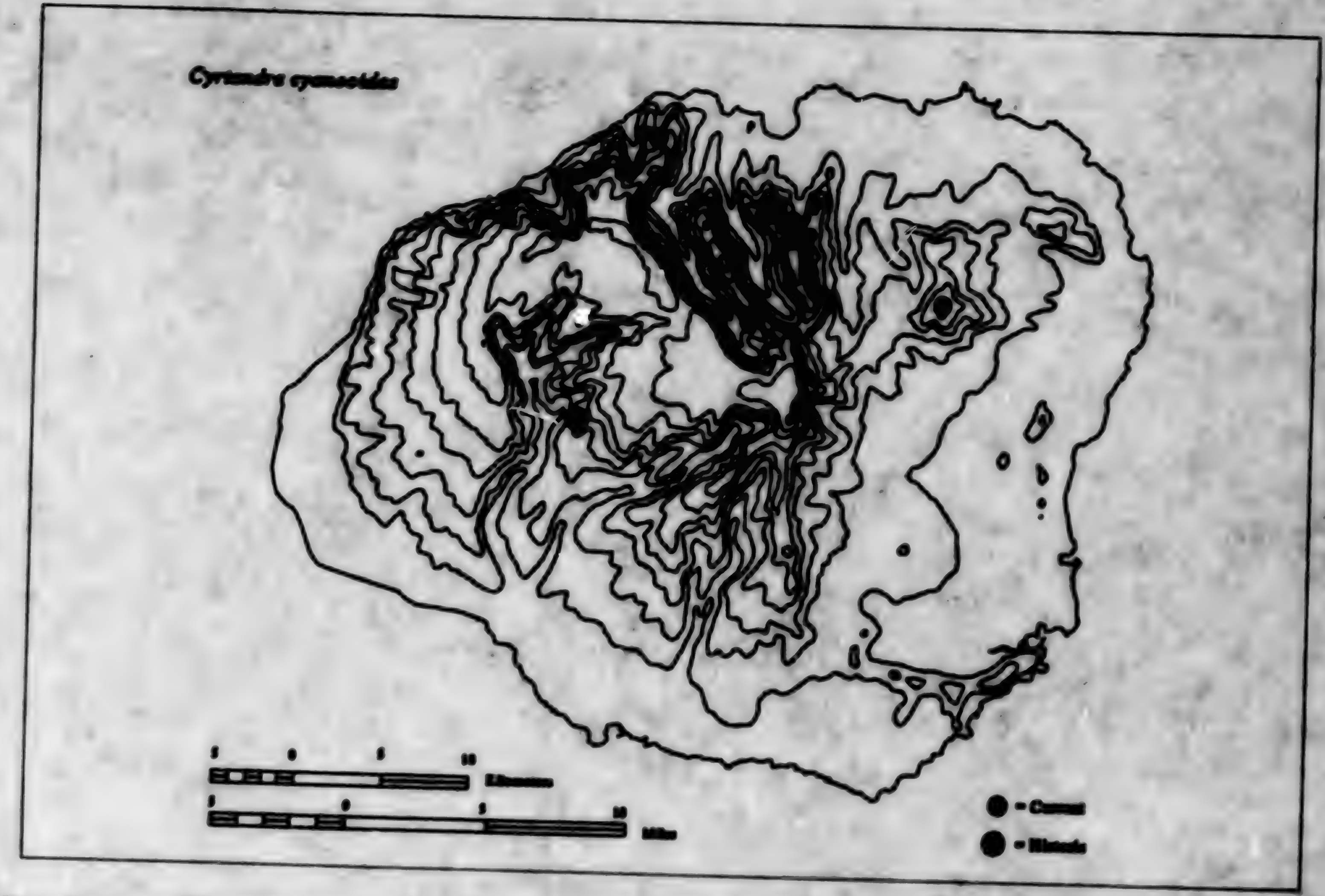
Current range and historical occurrences of *Alsinidendron viscosum* (no common name (NCN)) on Kauai.



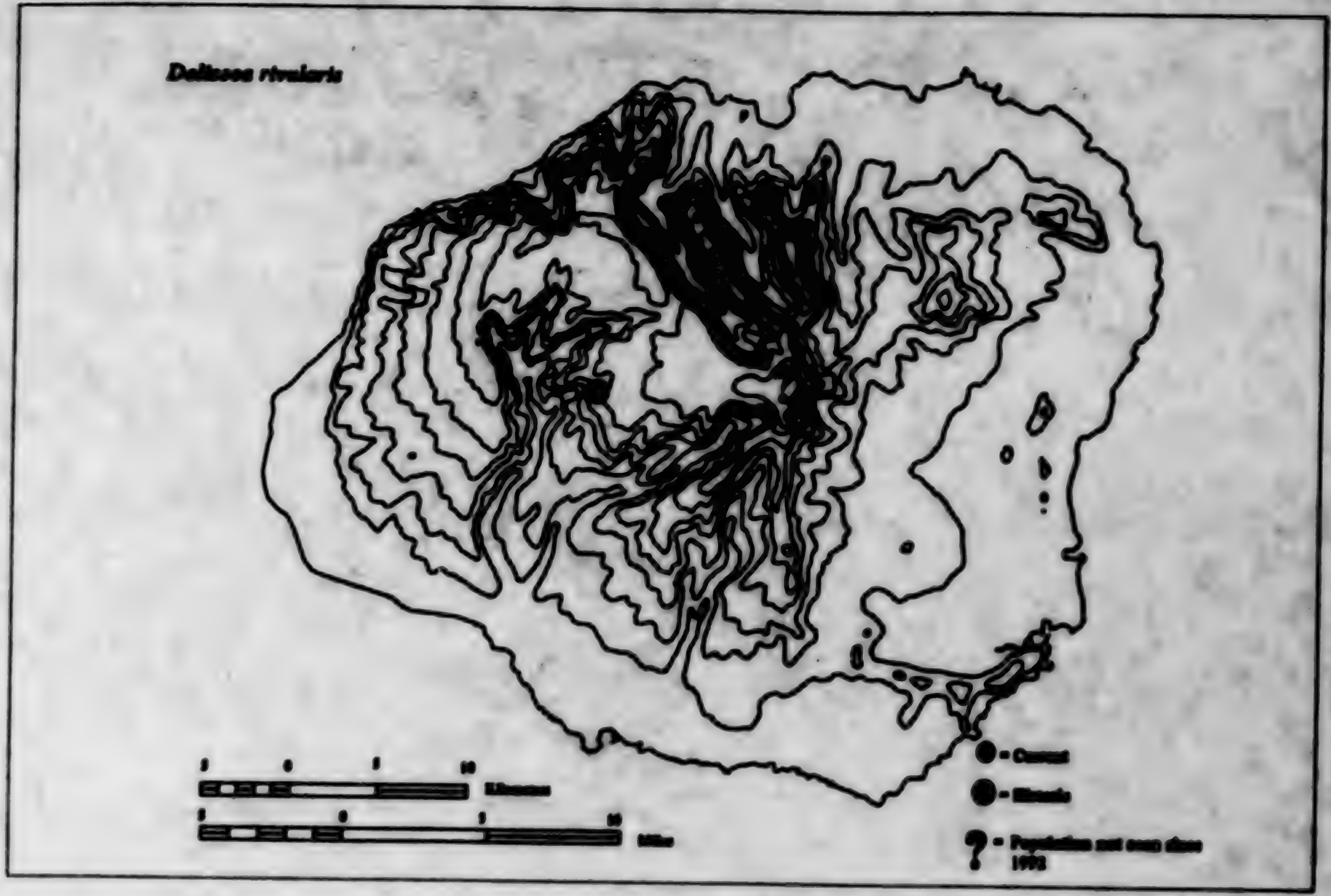
Current range and historical occurrences of *Cyanea recta* (haha) on Kauai.



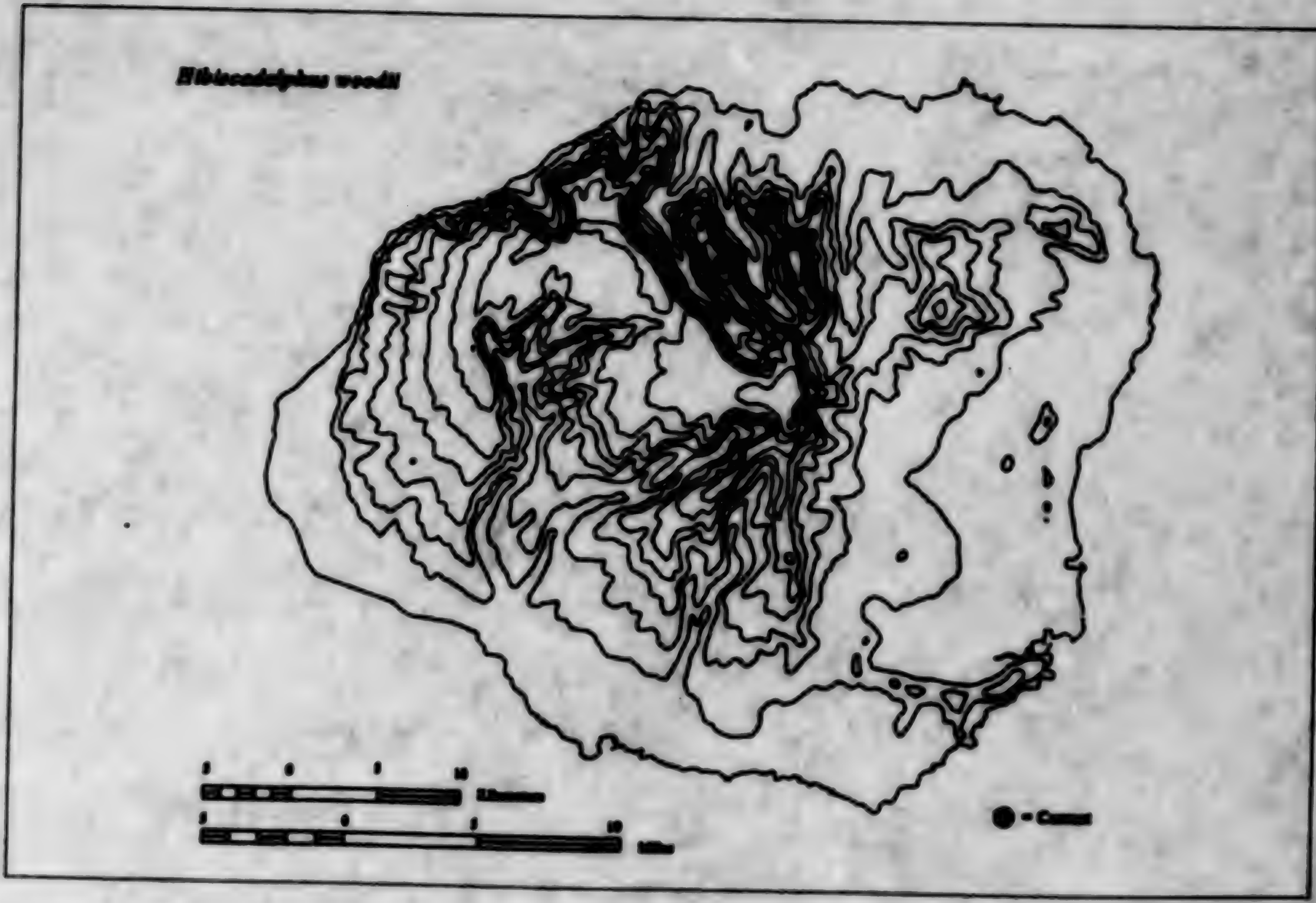
Current range of *Cyanea remyi* (haha) on Kauai.



Current range and historical occurrences of *Cyrtandra cyaneoides* (mapele) on Kauai.

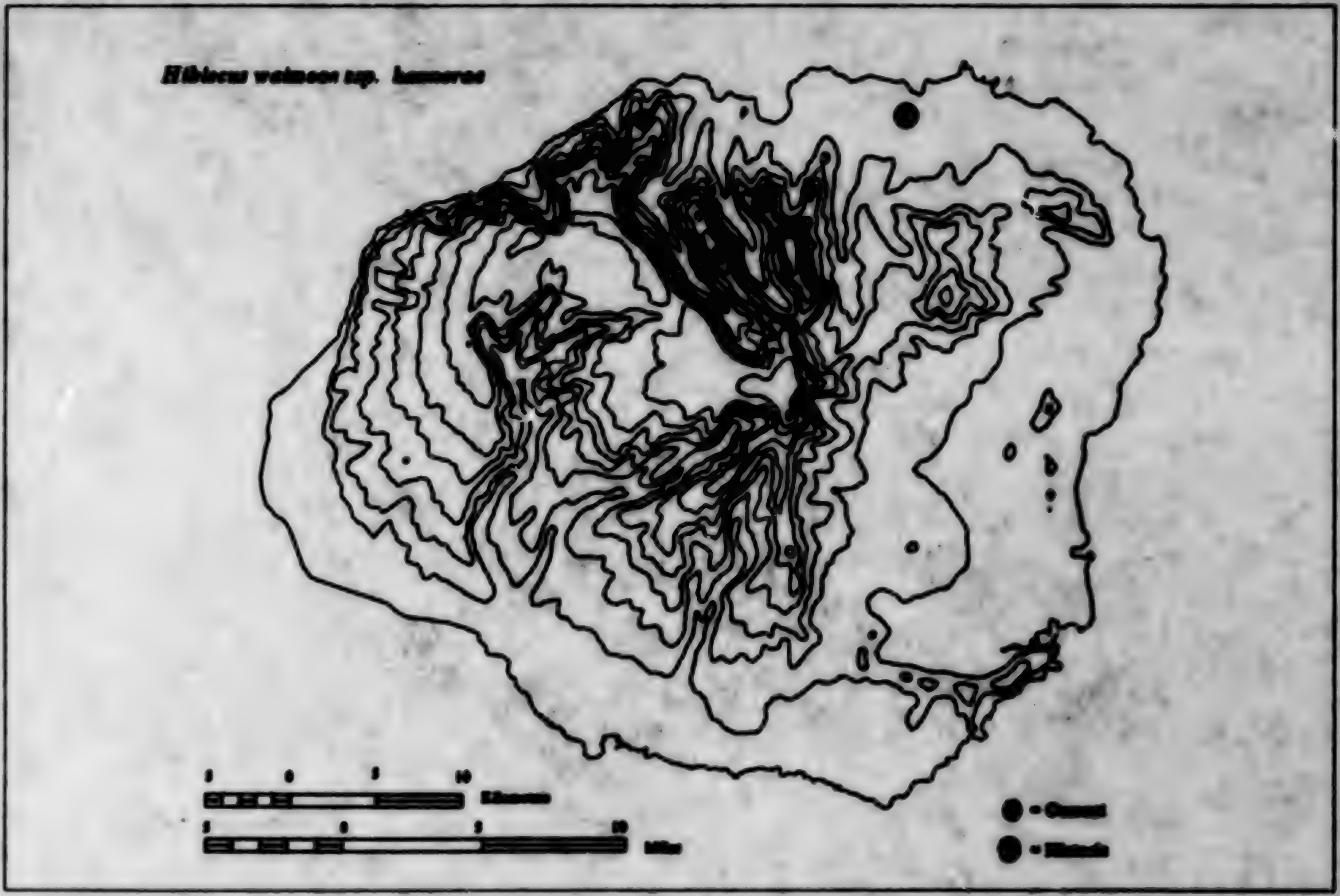


Current range and historical occurrences of *Delissea rivularis* (oha) on Kauai.

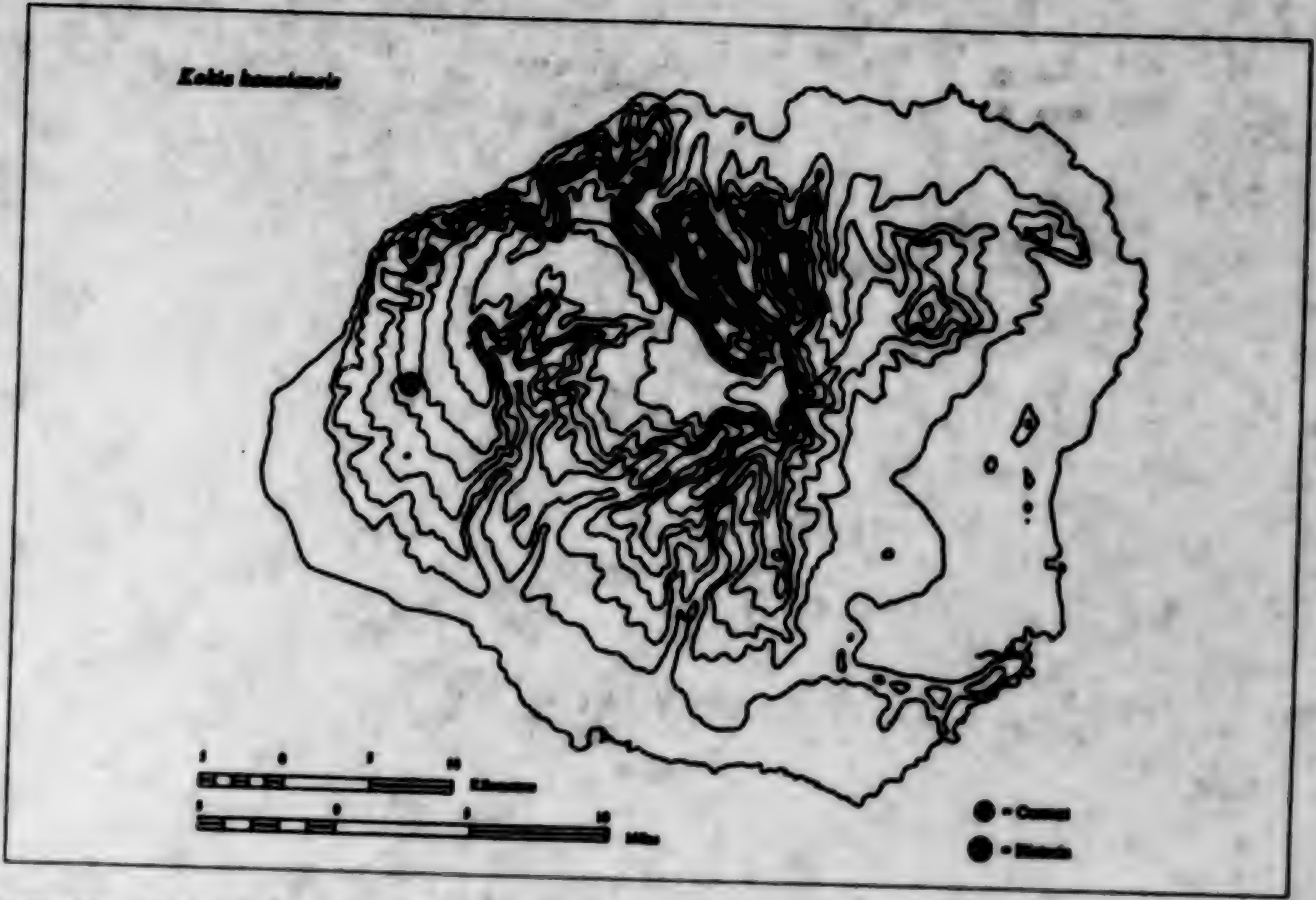


Current range of *Hibiscadelphus woodii* (hau kuahiwi) on Kauai.

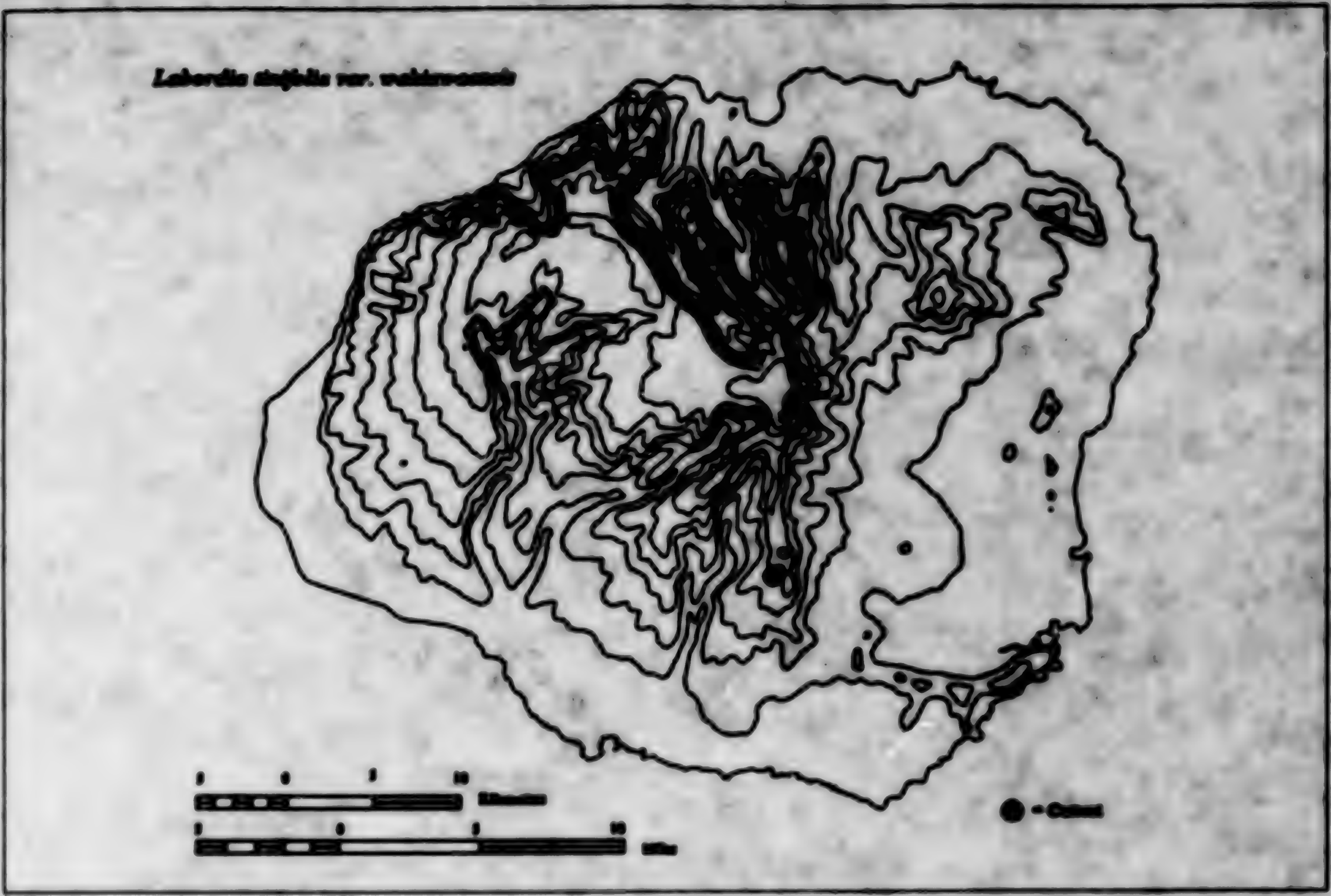
///



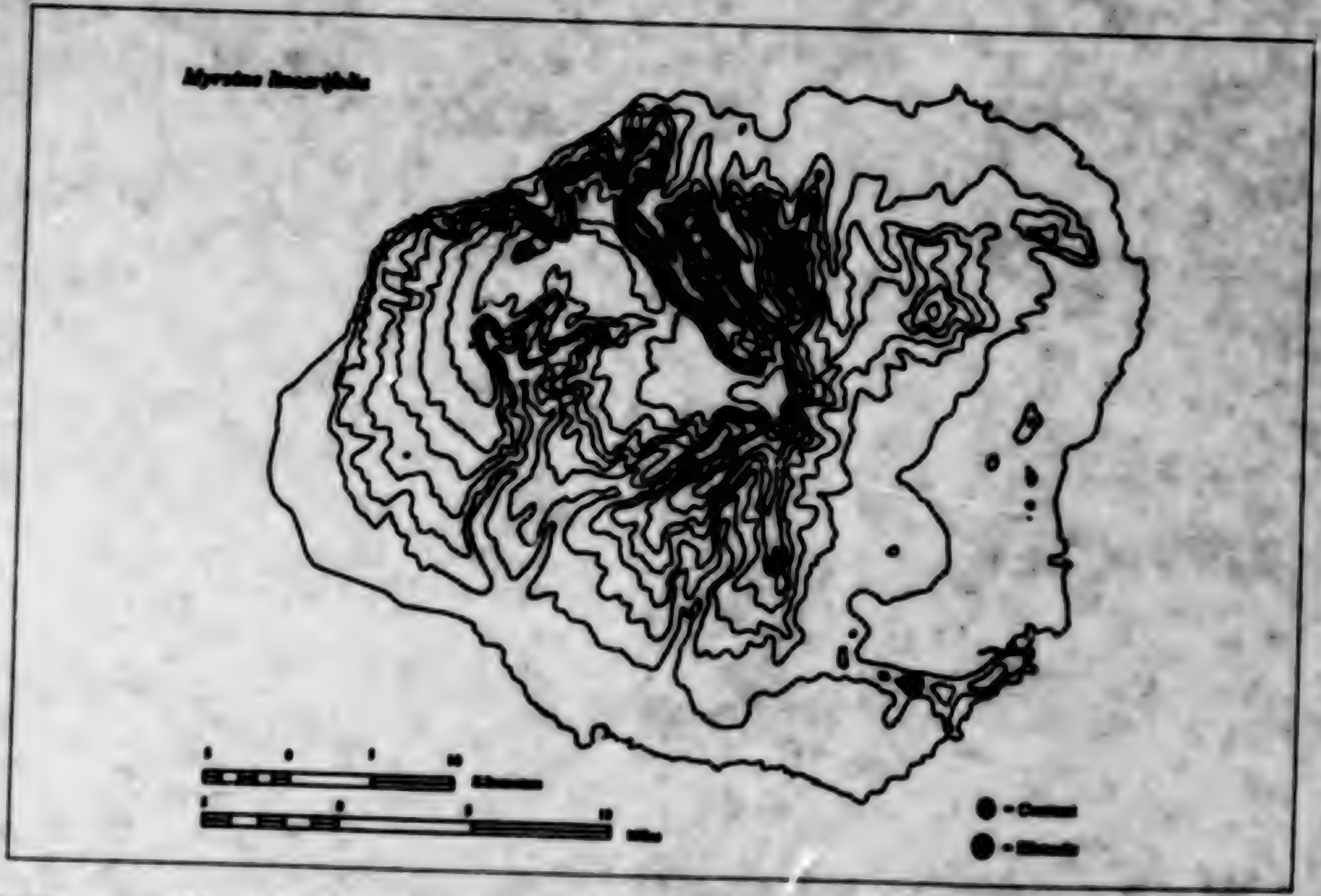
Current range and historical occurrences of *Hibiscus waimeae ssp. hannerae* (koki o keokeo) on Kauai.



Current range and historical occurrences of *Kokia kauaiensis* (kokio) on Kauai.

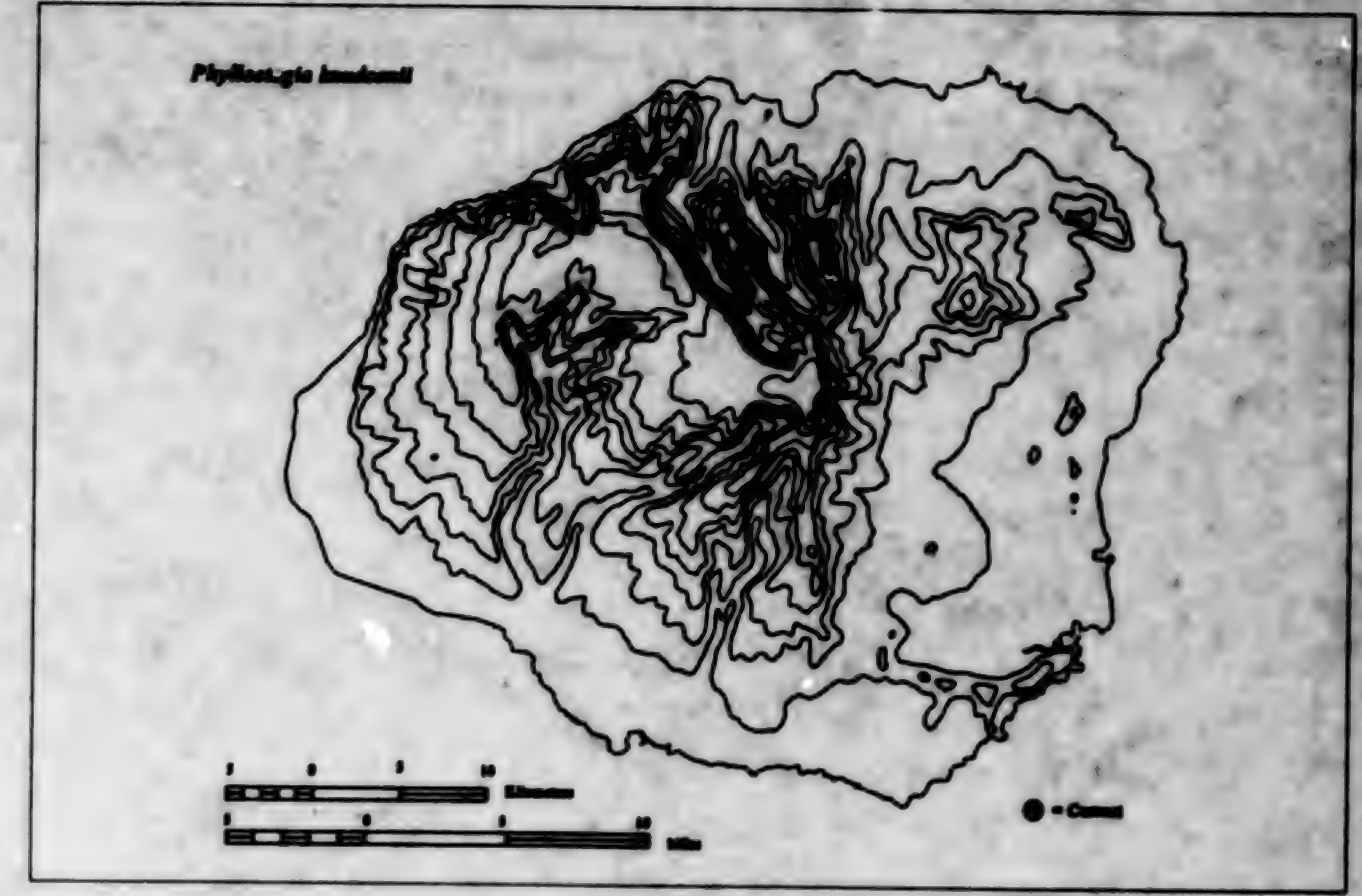


Current range and historical occurrences of *Labordia tinifolia* var. *wahiawaensis* on Kauai.

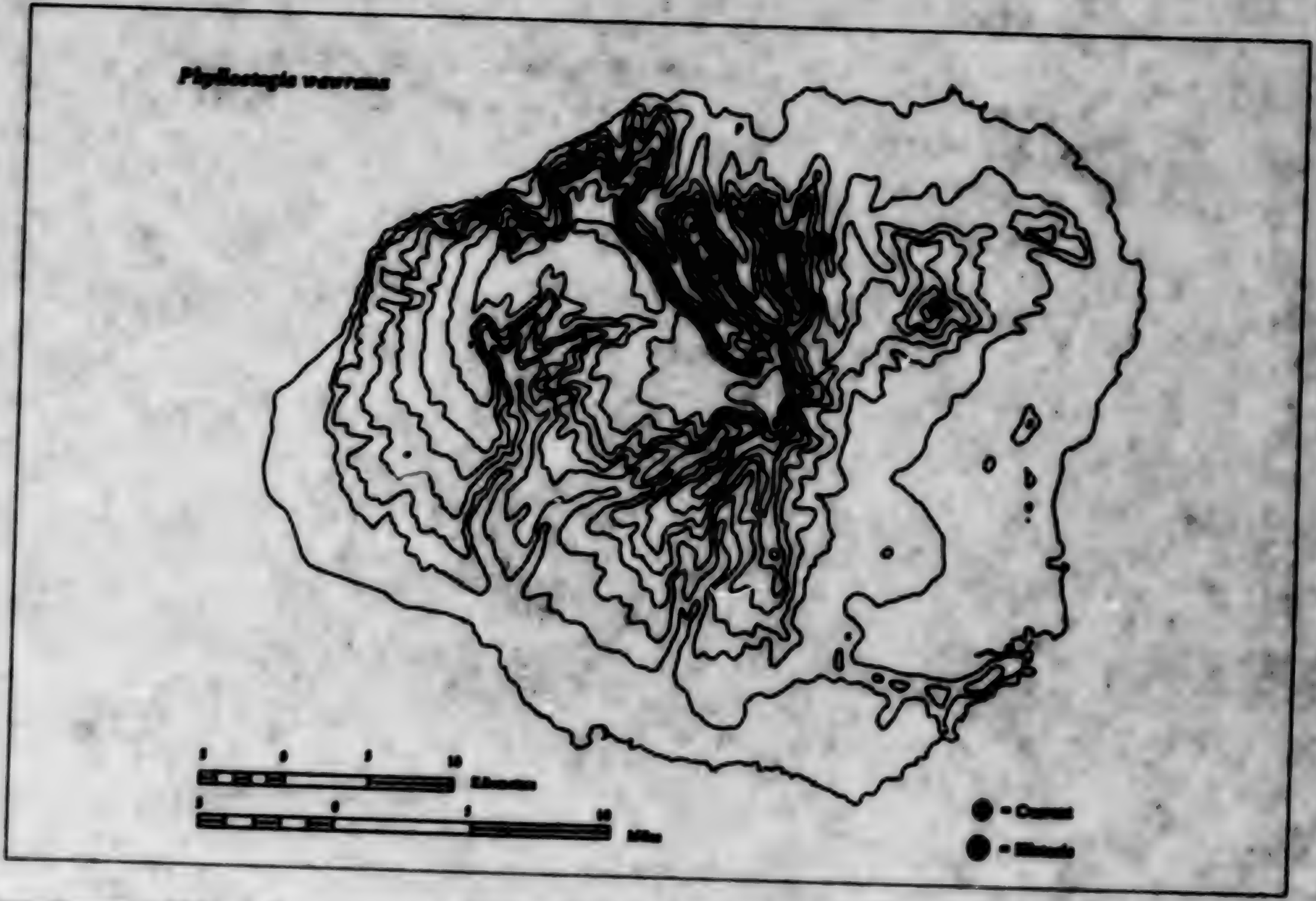


Current range and historical occurrences of *Myrsine linearifolia* (kolea) on Kauai.

K13

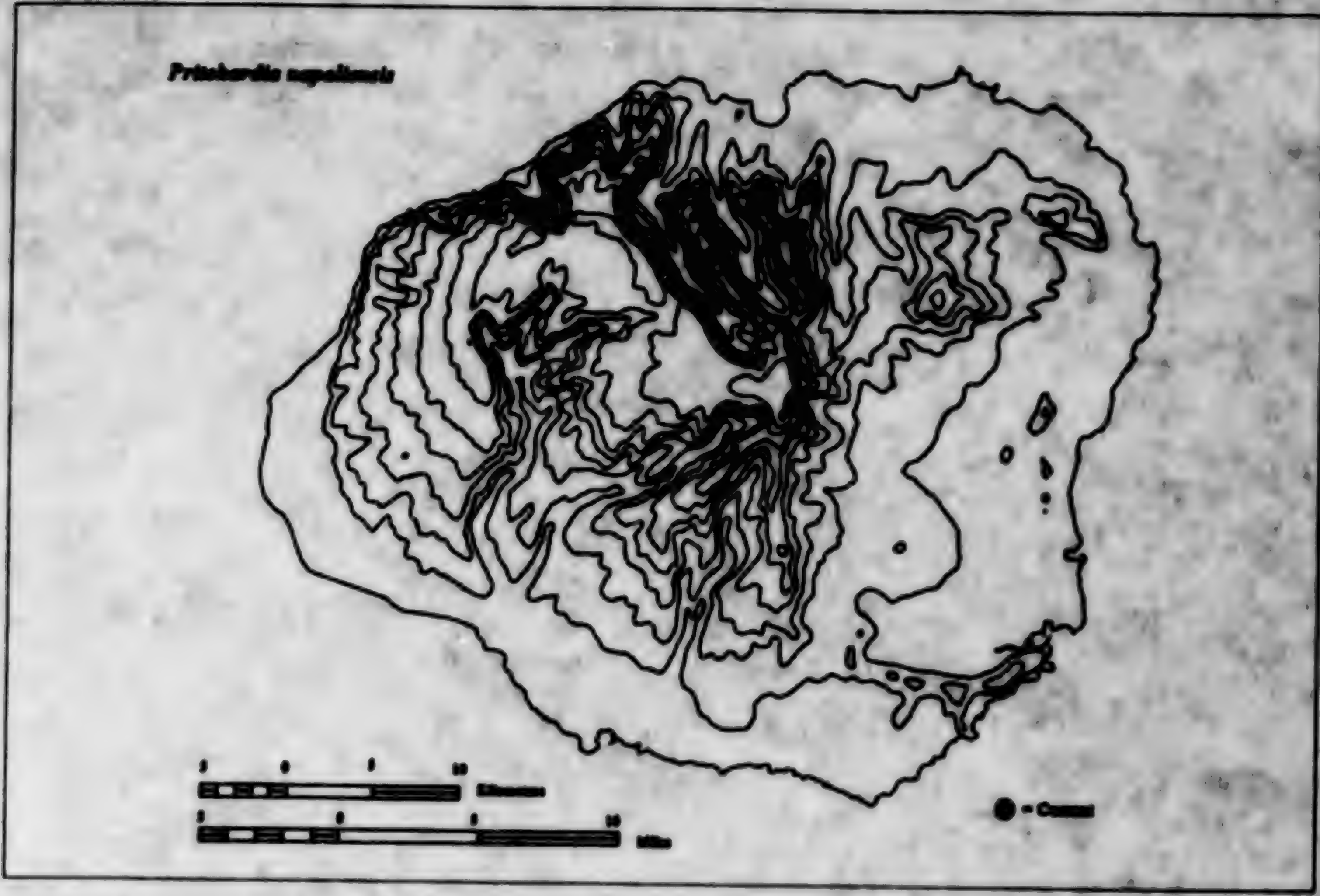


Current range and historical occurrences of *Phyllostegia knudsenii* (NCN) on Kauai.

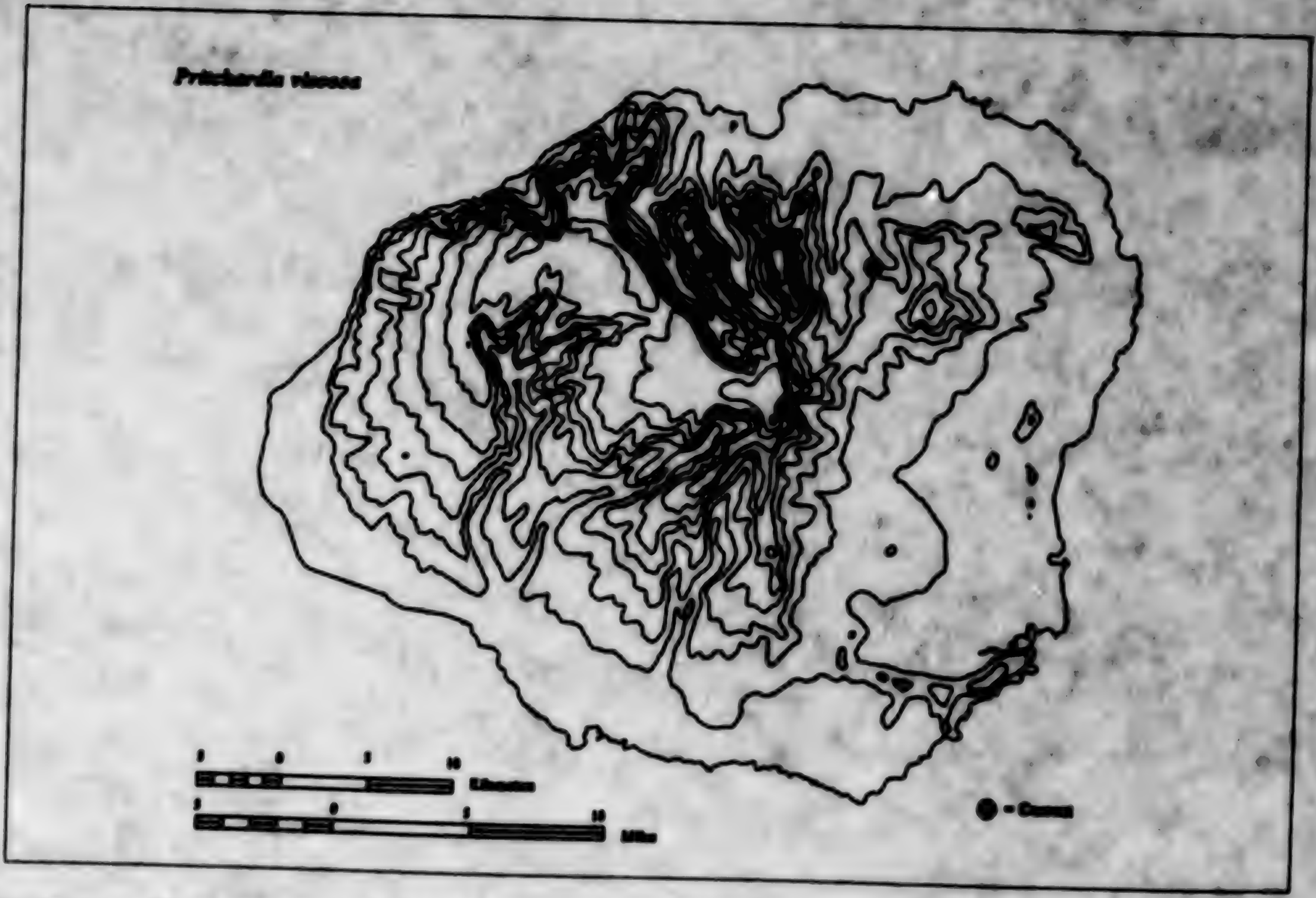


Current range and historical occurrences of *Phyllostegia wawrana* (NCN) on Kauai.

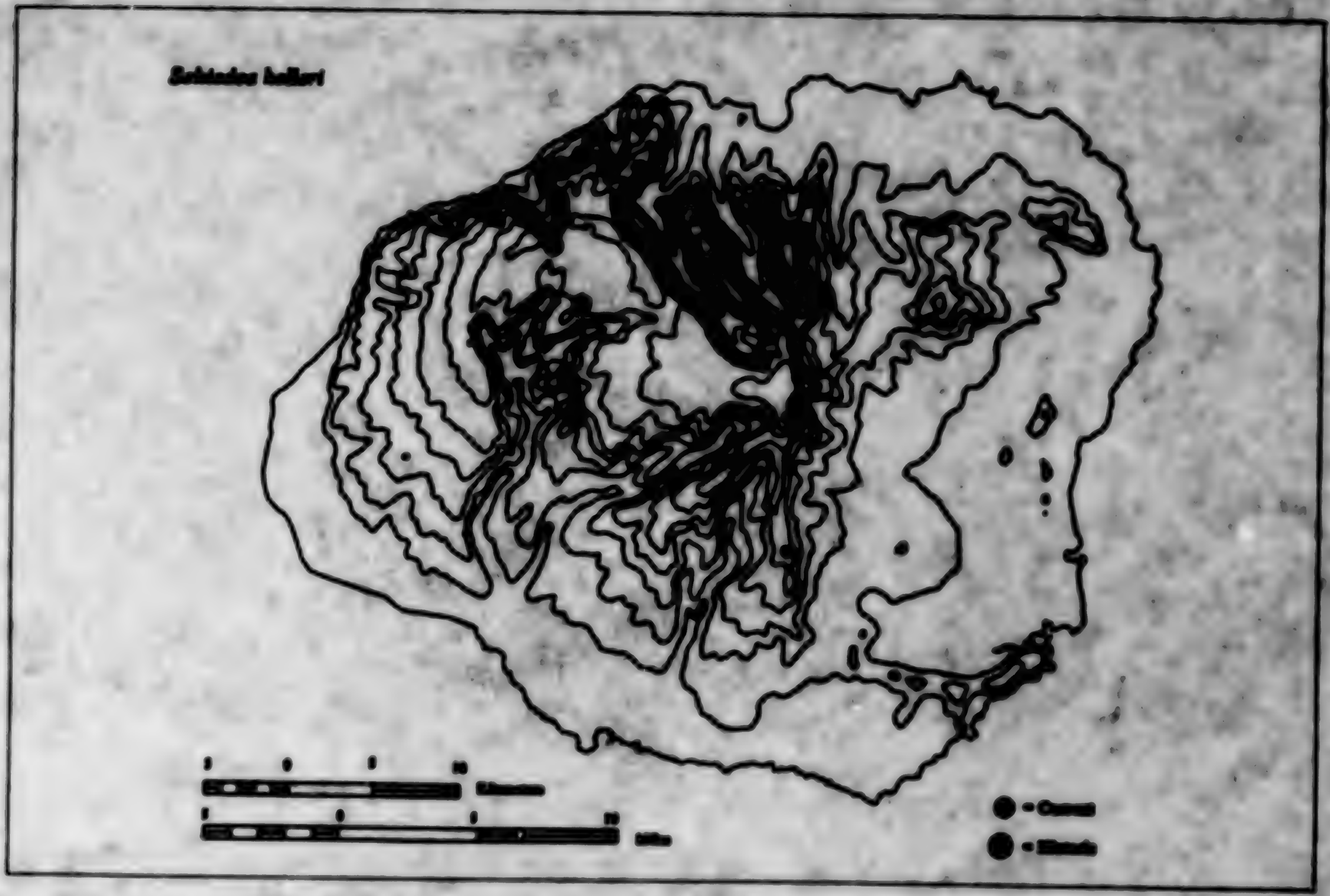
K15



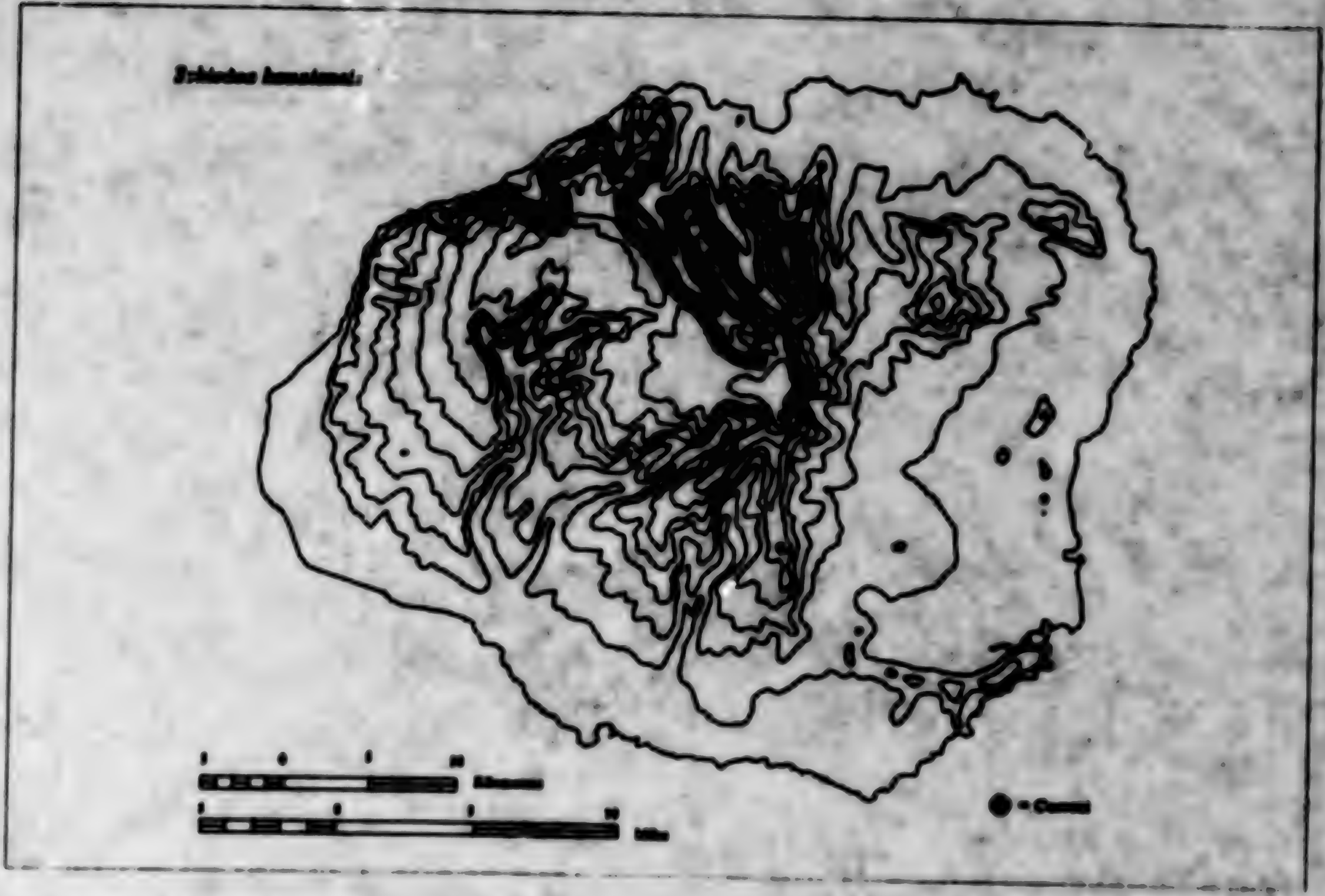
Current range of *Pritchardia napaliensis* (loulu) on Kauai.



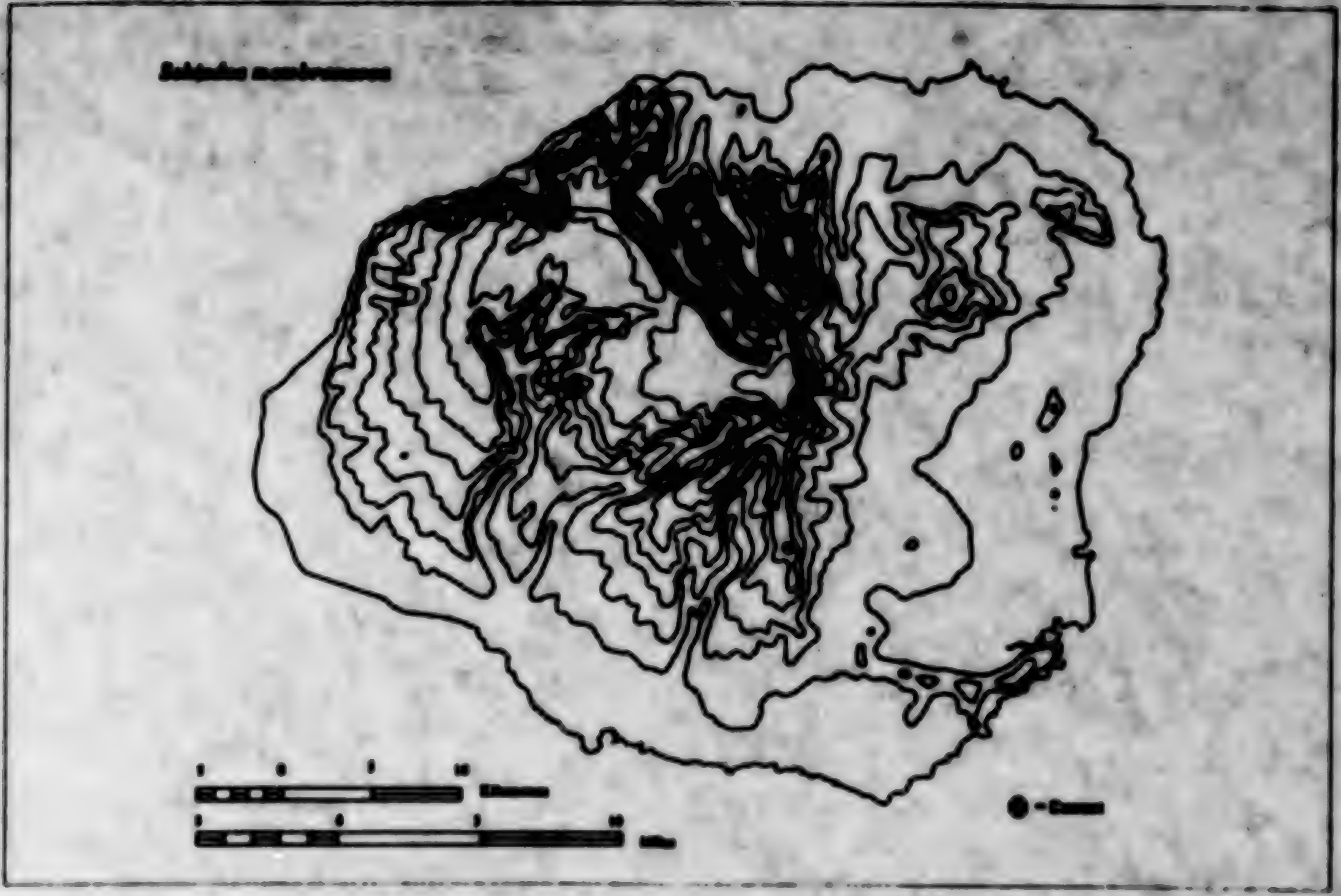
Current range of *Pritchardia viscosa* (loulu) on Kauai.



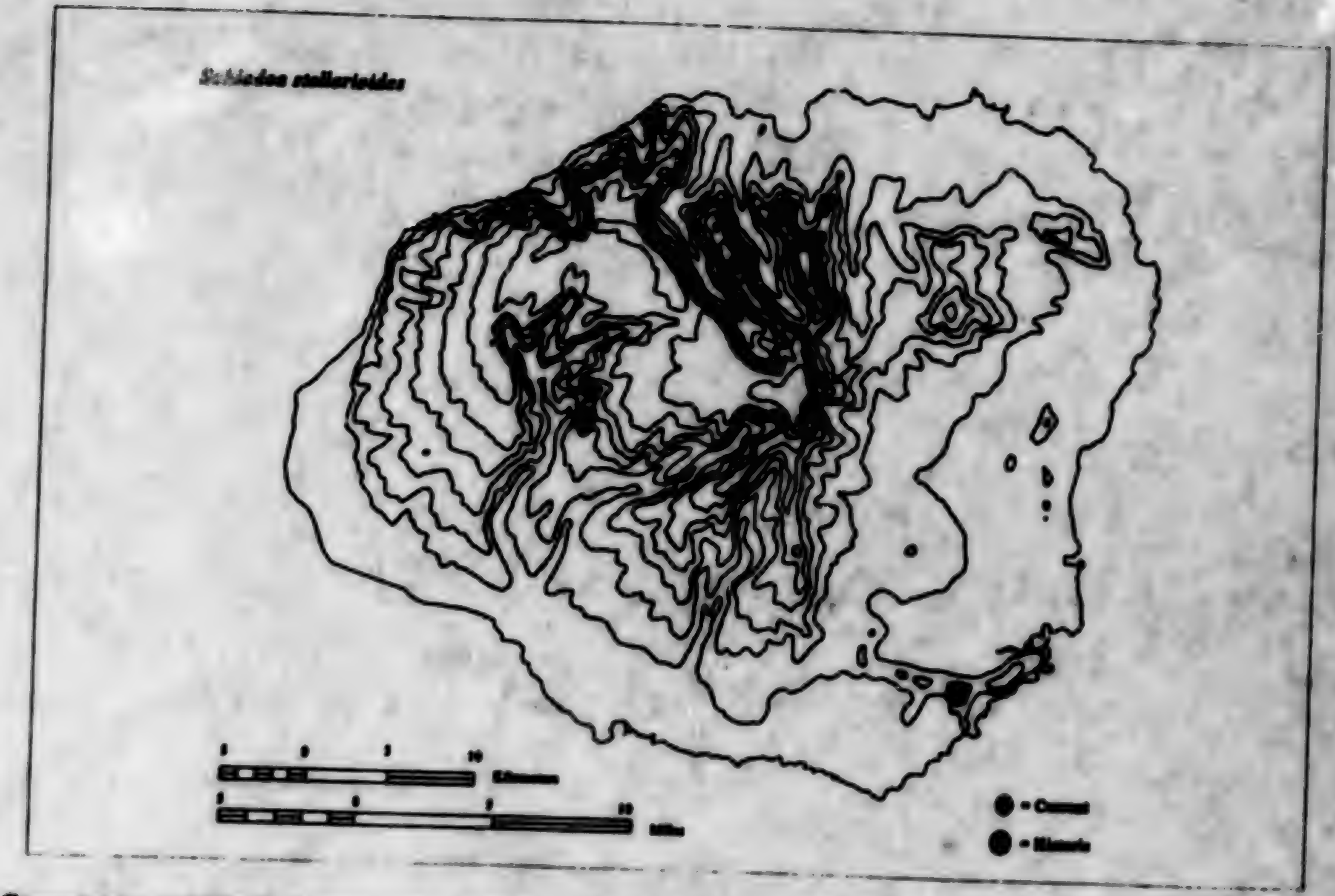
Current range and historical occurrences of *Schiedea helleri* (NCN) on Kauai.



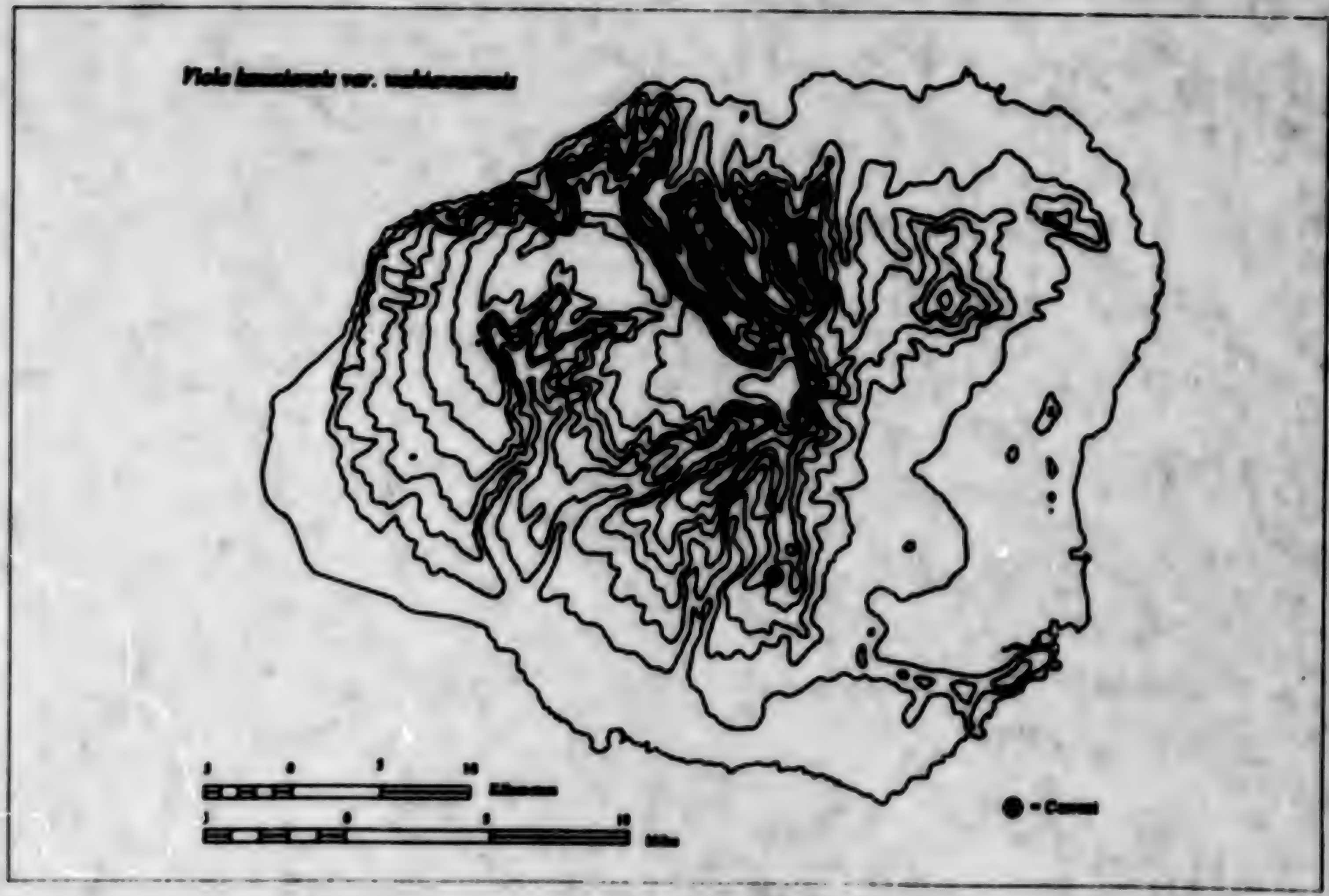
Current range of *Schiedea kauaiensis* (NCN) on Kauai.



Current range of *Schiedea membranacea* (NCN) on Kauai.



Current range and historical occurrences of *Schiedea stellarioides* (laulihilihi) on Kauai.



Current range *Viola kauaiensis var. wahiawaensis* (nani wai'ale'ale) on Kauai.

APPENDIX L
SUMMARY OF LANDOWNERSHIP AND MANAGEMENT

State of Hawaii

Alsinidendron lychnoides, Alsinidendron viscosum, Cyanea recta, Cyanea remyi, Cyrtandra cyaneoides, Delissea rivularis, Hibiscadelphus woodii, Hibiscus waimeae ssp. hannerae, Kokia kauaiensis, Myrsine linearifolia, Phyllostegia knudsenii, Phyllostegia wawrana, Pritchardia napaliensis, Pritchardia viscosa, Schiedea helleri, Schiedea kauaiensis, Schiedea membranacea, Schiedea stellarioides.

Private Landowners

Cyanea recta, Cyanea remyi, Cyrtandra cyaneoides, Hibiscus waimeae ssp. hannerae, Myrsine linearifolia, Labordia tinifolia var. *wahiawaensis, Schiedea membranacea, Viola kauaiensis* var. *wahiawaensis.*

APPENDIX M
SUMMARY OF COMMENTS

The U.S. Fish and Wildlife Service received comments on the Draft Kauai II: Addendum to the Recovery Plan for the Kauai Plant Cluster from the Division of Forestry and Wildlife, the Hawaii Department of Agriculture, the Hawaii Land Use Commission, the Hawaii Department of Transportation, the Office of Hawaiian Affairs, the National Tropical Botanical Garden, the Institute for Policy Research at Northwestern University, the University of California at Irvine, the U.S. Department of the Air Force, and the U.S. Marine Corps. Most of these comments provided additional information on numbers of individuals or populations, distribution of certain taxa, changes to cost estimates for tasks in the Implementation Schedule, and editorial changes. These comments have been incorporated into the final plan. Additional comments are addressed specifically below. The following peer reviewers provided comments on the plan: Marie Bruegmann, Carolyn Corn, Steve Perlman, Ken Wood, and Steve Weller.

Comment 1: Insects, such as the two-spotted leafhopper (*Sophonia rufofascia*), which has received much press on its negative impact on both native and alien plant species in Hawaii since its introduction in 1987, should be included as possible reasons for the decline of some of the plants included in this Recovery Plan.

Service Response: The direct impacts of alien insects, when observed and documented, have been included in the discussion associated with each plant species. Because there may be additional impacts from alien insects on these plants, further research and control of alien insects have been included in the Stepdown Outline and Narrative (see U.S. Fish and Wildlife Service. 1995. Recovery Plan for the Kauai Plant Cluster. U.S. Fish and Wildlife Service, Portland, OR. 270 pp.) and in the Recovery Task Implementation Schedule for Kauai and Kauai II Plant Clusters (Task 1253).

Comment 2: Soil and environmental stresses also contribute to high mortality among young plants in plant propagation programs and the Recovery Plan should include research on these issues.

Service Response: Further research on soils and environmental stresses is addressed in the Stepdown Outline and Narrative (see U.S. Fish and Wildlife Service. 1995. Recovery Plan for the Kauai Plant Cluster. U.S. Fish and Wildlife Service, Portland, OR. 270 pp.) and in the Recovery Task Implementation Schedule for Kauai and Kauai II Plant Clusters (Tasks 23, 24, and 33).

Comment 3: Some "ecosystem weeds" are not mentioned in any of the 19 species threat accounts. It is unclear, when given limited personnel, time, and monies, which alien plant species are highest priority for control and/or eradication.

Service Response: There is a need for further research on which alien plant species pose the greatest threats for each taxon in this Addendum and further research on alien plant control, alien plant mapping, and degree of threat is outlined in the Stepdown Outline and Narrative (see U.S. Fish and Wildlife Service. 1995. Recovery Plan for the Kauai Plant Cluster. U.S. Fish and Wildlife Service, Portland, OR. 270 pp.) and in the Recovery Task Implementation Schedule for Kauai and Kauai II Plant Clusters (Task 121,123,1211,32,1210,37, and 38).

Comment 4: The difference in costs between recovery plans for different islands is high. Is there some formula used to derive these figures?

Service Response: Costs given in Implementation Schedules are rough estimates. In many cases costs are related to accessibility of the plants or suitable habitat for outplanting. It may be possible to combine tasks for a number of species that occur in the same area, for example, thus minimizing overall costs. Additionally, many of the Recovery plans for endangered and threatened Hawaiian plants outline the need for research on the control of alien plants and insects. This research may be carried out simultaneously for a number of these plants.

Comment 5: Which species would be affected if rodenticide were aerial dispersed?

Service Response: Research to determine the effects of aerially dispersed rodenticide is addressed in the Stepdown Outline and Narrative (see U.S. Fish and Wildlife Service. 1995. Recovery Plan for the Kauai Plant Cluster. U.S. Fish and Wildlife Service, Portland, OR. 270 pp.) and in the Recovery Task Implementation Schedule for Kauai and Kauai II Plant Clusters (Task 1251). Table 3 of this addendum lists the plants most affected by rodents.

Comment 6: Almost all of the taxa have a statement that "No life history information ... is currently available." This information is needed to ascertain additional threats, propagation and outplanting techniques, and best management techniques. Research on these species should be given emphasis. More flowering and fruiting phenology information could be given by reviewing herbarium sheets.

Service Response: Herbarium specimens were examined in the preparation of this plan. However, phenological data from specimens does not reflect typical flowering and fruiting times since collectors often collect from any flowering or fruiting individual whether or not the majority of the population is flowering. Available phenological information was incorporated into this recovery plan.

Comment 7: A table showing the threats should be included in the plan.

Service Response: Threats to each of the plants is summarized in Table 3 and in the individual species accounts.

Comment 8: A table summarizing the alien plants and associated plants for the individual plants would be helpful.

Service Response: This information is provided in Table 1. The Fish and Wildlife Service has identified the appropriate habitat type(s) for each of the 20 taxa in this addendum because we believe that this would be a more useful aid in their management. Also included in Table 1 is a list of associated plants that may be appropriate for restoration efforts in these habitat types. The Fish and Wildlife

Service hopes that by identifying both the alien invasive plants and native plants for specific habitat types, management can be accomplished on an ecosystem scale rather than on a species-by-species approach.

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END

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